

Development of Clinical Pharmacy Key Performance Indicators for Ambulatory Oncology Using a Modified Delphi Approach

by

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AUTHOR'S DECLARATION

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

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ABSTRACT

Introduction: Ambulatory Oncology Clinical Pharmacy Key Performance Indicators

(AOcpKPIs) are quantitative measures that reflect the quality of care provided by pharmacists to ambulatory oncology patients. In this research project, AOcpKPIs were selected to advance pharmacy practice to improve patient outcomes. Research completed prior to this work involved a cross-sectional survey as part of a Canadian environmental scan. This survey revealed that 98% of respondents supported the development of AOcpKPIs for ambulatory oncology pharmacy practice. The primary objective of this project was to identify targeted processes of care aimed at improving ambulatory oncology patient outcomes represented by critical activity topics (pharmacist interventions), which were used to develop quantifiable AOcpKPIs.

Methods: A literature review on evidence-informed critical activity topics revealed that certain care processes delivered by ambulatory oncology pharmacists had a positive impact on patient outcomes. A steering group comprised of expert ambulatory oncology pharmacists created evidence summary tables by critically appraising and assessing articles to identify “Ambulatory Oncology Critical Activity Topics”. A list of 15 candidate AOcpKPIs was generated by the steering group to serve as metrics to represent 9 evidence-linked critical activity topics. A sample of 18 pharmacists was purposively selected by the steering group to participate in a Delphi panel with the goal of reaching consensus on AOcpKPIs to adopt.

This research project employed a modified Delphi process (a structured method to reach consensus among experts through multiple rounds of surveys and discussion in a meeting) where panelists ranked the *a priori* selected candidate AOcpKPIs on a 9-point Likert scale in the initial round and then reviewed the rankings and comments of the first round to re-rank the 15 AOcpPKIs in round 2. A final consensus was reached in the third round following a live meeting

discussing marginal candidate AOcpPKIs from the second round.

Results: After the first round of the Delphi process, 9 candidate AOcpPKIs reached preliminary consensus. This number increased to 12 after the second round. During a live meeting, discussions about the wording and meaning of the candidate AOcpPKIs led to the addition of 2 new candidates, totaling to 17 for the third round. Following the third round, 14 AOcpPKIs achieved consensus. These cpPKIs highlight essential pharmacist contributions, such as reviewing clinical orders, providing patient education on medications, assessing medication adherence, pharmaceutical care plan (oncology), pharmaceutical care plan (non-oncology), follow-up, bundled patient care interventions, medication history assessment and addressing drug therapy issues.

Significance: This research project identified 14 quantifiable AOcpPKIs, based on ambulatory oncology patient outcomes, that represent critical activity topics. Through a systematic, evidence-informed consensus-building process, the final suit of consensus AOcpPKIs that improve patient outcomes were formed. Future efforts will focus on implementing these metrics in ambulatory oncology pharmacy practice to measure and ensure the quality of patient care.

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Last but not least, my sincere thanks to the steering group and Delphi panelists that participated in my research project which helped guide the project forward in establishing relevant ambulatory AOcpKPIs needed in ambulatory oncology.

DEDICATION

To my loving husband, your unwavering support, guidance and belief in me made all the difference throughout my MSc journey, and I could not have done it without you – thank you for being my rock.

TABLE OF CONTENTS

Author's Declaration.....	ii
Abstract.....	iii
Acknowledgements.....	v
Dedication.....	vi
Table of Abbreviations.....	x
List of Figures.....	xiii
List of Tables.....	xiv
 Chapter 1: Introduction.....	 1
 Chapter 2: Pre-Delphi Methodology.....	 7
Overall Methodology.....	8
Pre-Delphi Steps (Steps 1-8b).....	10
Step 1: Establishment of a consensus 5-point AOcpKPI definition.....	10
Step 2: Establishment of a consensus 9 selection criteria.....	11
Step 3: National call for potential critical activity topics/candidate AOcpKPIs.....	13
Step 4a: Literature Search and Assessment.....	14
Step 4b: Preparation of evidence summary tables.....	57
Step 5: Establishment of evidence-informed critical activity topics.....	58
Step 6: Establishment of candidate AOcpKPIs for the Delphi Process.....	66
Step 7: Delphi Survey Tool Creation.....	68
Step 8a: Delphi panel selection, recruitment, and consent process.....	70
Step 8b: Education Training Package.....	72
 Chapter 3: Modified Delphi Methodology (Steps 9-10).....	 73

Step 9: 3-round Delphi process.....	73
Step 10: Consensus and Final Review of Candidate AOcpKPIs.....	75
Post-Delphi Phase.....	75
Chapter 4: Results.....	76
Delphi Panel Demographics.....	76
Round 1 Delphi Results.....	80
Round 2 Delphi Results	91
Live Meeting... ..	99
Round 3 Delphi Results and Final Consensus AOcpKPIs... ..	106
Chapter 5: Discussion	121
Strengths and limitations	122
Literature search... ..	122
Modified Delphi process	122
Significance of AOcpKPIs... ..	124
Future Directions... ..	125
Implementation Process of AOcpKPIs... ..	125
Conclusion.....	128
References... ..	129
Appendices.....	135
Appendix A: Evidence Summary Tables.....	135
Appendix B: Round 1 Delphi Verbatim Comments Table.....	196

Appendix C: Round 2 Delphi Verbatim Comments Table.....	209
Appendix D: Round 3 Delphi Verbatim Comments Table.....	218
Appendix E: Delphi Panel Characteristics Table.....	226
Appendix F: Relationship between Research team, Delphi panelists, steering group and general population of ambulatory oncology pharmacists.....	228
Appendix G: Research Team and Steering Group Personnel.....	236

TABLE OF ABBREVIATIONS

ACPR	Accredited Canadian Pharmacy Residency
ADR	Adverse Drug Reactions
AHRQ	Agency for Healthcare Research and Quality
ALL	Acute Lymphoid Leukemia
AOcpKPI	Ambulatory Oncology Clinical Pharmacy Key Performance Indicator
ARR	Absolute Risk Reduction
ASCO	American Society of Clinical Oncology
BP	Blood Pressure
BPI	Brief Pain Inventory
BPMH	Best Possible Medication History
BSc	Bachelor of Science
BScPhm	Bachelor of Science in Pharmacy
CAPhO	Canadian Association of Pharmacy in Oncology
CG	Control Group
CI	Confidence Interval
CINV	Chemotherapy Induced Nausea and Vomiting
cpKPI	Clinical Pharmacy Key Performance Indicator
CSI	Clinically Significant Interactions
CTCAE	Common Terminology of Criteria for Adverse Events
DRPs	Drug Related Problems
DTP	Drug Therapy Problem

ED	Emergency Department
EKG	Electrocardiogram
ESAS	Edmonton Symptom Assessment Scale
HR	Heart Rate
ICIs	Immune Checkpoint Inhibitors
IDS	Investigational Drug Services
IQR	Interquartile Range
irAE	Immune Related Adverse Events
ISOPP	International Society of Oncology Pharmacy Practitioners
IV	Intravenous
KPI	Key Performance Indicator
MBA	Master of Business Administration
MM	Multiple Myeloma
MRPs	Medication Related Problems
MSc	Master of Science
MUSE	Medication Understanding and Use Self-Efficacy
NCCH	North Carolina Cancer Hospital
NCI	National Cancer Institute
NHL	Non-Hodgkin Lymphoma
OR	Odds Ratio
OPT	Oncology Pharmacy Team
PD-1	Programmed Death-1
PD-L1	Programmed Death-1 Ligand

PFS	P rogression F ree S urvival
PG	P harmacist Intervention G roup
PharmD	D octor of P harmacy
QI-DTPs	Q uality I ndicator D rug T herapy P roblems
QoL	Q uality o f L ife
RCT	R andomized C ontrolled T rial
RDI	R elative D ose I ntensities
SD	S tandard D eviation
TSQM	T reatment S atisfaction Q uestionnaire for M edication

LIST OF FIGURES

Figure 1: Three-Phase Process for Developing and Implementing AOcpKPIs	6
Figure 2: Overview of the Modified Delphi Process for Developing AOcpKPIs.....	7
Figure 3: Literature Search PRISMA diagram.....	17
Figure 4: Delphi Survey Instrument Example Designed using Qualtrics.....	70
Figure 5: Round 1 Analysis of AOcpKPI #1: Graphical Data Visualization.....	86

LIST OF TABLES

Table 1: Comparative Analysis of Slavik 11 and Project-Specific 9 AOcpKPI Selection Criteria	12
Table 2: Literature Search Results of Ambulatory Oncology Pharmacy Studies.	18
Table 3: Illustrative Example of Evidence Summary Tables.....	60
Table 4: Demographic Breakdown of Delphi Panelists.....	74
Table 5: Round 1 Delphi Results.	81
Table 6: Example of Round 1 Panelist Dashboard	87
Table 7: Prevalent Delphi Comments from Round 1.....	89
Table 8: Round 2 Delphi Results.	92
Table 9: Prevalent Delphi Comments from Round 2.....	97
Table 10: Chart Summary of Changes in Delphi Candidate AOcpKPIs Post-Live Meeting.	101
Table 11: Clarified Key Definitions for Panelists in Delphi Process	105
Table 12: Round 3 Delphi Results.	107
Table 13: Prevalent Delphi Comments from Round 3.....	113
Table 14: Consensus Clinical Pharmacy Key Performance Indicators (AOcpKPIs).....	116
Table 15: Ranking of Pre-Delphi Consensus AOcpKPI Critical Activity Topics.	119
Table 16: Data Calculation Example for Critical Activity Topic: Pharmacist-Led Clinical Medication Order Review.....	120
Table 17: Roles and Responsibilities Overview in the Modified Delphi Research Project.....	230

CHAPTER 1: INTRODUCTION

Ambulatory oncology pharmacy is a subset of ambulatory care encompassing oncology based care provided in various settings like specialized community pharmacies and outpatient oncology hospital clinics.¹ Ambulatory care pharmacists play a vital role in preparing and dispensing systemic therapies including verifying orders, identifying medication-related problems, and ensuring medication safety.¹ They also serve in clinical consultative roles, providing patient medication education, offering follow-up care, and monitoring therapeutic outcomes.¹ Many pharmacists in this field perform a combination of these tasks, integrating both clinical and dispensing duties to improve patient care in outpatient settings.¹

Changing patient needs have led to an evolution in the clinical role of oncology pharmacists, with a growing focus on direct patient-centered care.² The interprofessional healthcare team increasingly relies on these pharmacists to optimize drug therapy, explore alternative therapeutic options, and educate the team about advancements in drug therapy.² In outpatient settings, this has given rise to specialized ambulatory oncology pharmacists.² These specialists manage medications throughout the cancer treatment process from diagnostic assessment to treatment decision-making and symptom management, working closely with patients and other healthcare professionals to optimize complex anticancer therapies.^{2,3}

Given the complexity and critical nature of cancer treatment, it is essential to evaluate the effectiveness of the specialists' contributions in managing medication throughout the process.³ Key Performance Indicators (KPIs) are metrics that organizations use to evaluate how well they are meeting their specific objectives.⁴ Peter Drucker, a notable figure in management theory, laid out the groundwork for modern KPI concepts.⁴ During the early 1990s, Robert S. Kaplan and David P. Norton developed the Balanced Scorecard, a management framework that

popularized KPIs by facilitating performance monitoring across multiple perspectives.⁵ KPIs were created to provide quantifiable measures of success, enabling organizations to track advancement toward key goals and make data-driven decisions, serving as essential tools across various sectors, including business and healthcare.⁴

Clinical Pharmacy Key Performance Indicators (cpKPIs) are specifically designed to assess the effectiveness and impact of clinical pharmacy services in healthcare settings, with a focus on evidence-based improvements in patient outcomes.⁶ By measuring and evaluating the performance and impact of clinical pharmacy services, cpKPIs ensure that services meet established standards and goals, hold pharmacists accountable for their contributions, and enable performance comparisons across different healthcare settings.⁶ This comparison helps identify best practices and encourages the adoption of successful strategies to improve patient outcomes.⁶

The development of cpKPIs typically involves collaboration among various stakeholders in the healthcare sector, often using methods like the Delphi technique to achieve consensus on quality indicators to use in practice.⁷ The Delphi technique (named after the ancient Greek town that hosted a foreseeing priestess) was first created in the early 1950s at the RAND Corporation by Dalkey and Helmer.^{8,9} The Delphi method was developed to effectively compile a reliable consensus among specialists through a structured process of detailed questionnaires and systematic feedback.⁸ This approach proves particularly advantageous in areas where acquiring accurate data may be difficult or too costly.⁸ The Delphi method features several rounds of questionnaires, expert feedback on responses, revisions of their answers in subsequent rounds, and anonymity.⁸ The traditional Delphi method by Dalkey and Helmer has evolved into other variations such as the Modified Delphi.¹⁰

The Modified Delphi method differs from the original Delphi by including a face-to-face meeting, which provides panel members the opportunity to clarify points and present arguments to support their views more efficiently.¹⁰ Without this interaction, experts might miss key exchanges and fail to resolve disagreements within the limited rounds of questionnaires.¹⁰ The final meeting addresses potential issues and controversies, either by reaching a consensus or exploring alternatives, which helps policy makers arrive at informed decisions.¹⁰ This method has been widely used to facilitate discussions on complex clinical issues that initially lack consensus, such as developing a comprehensive suite of cpKPIs for ambulatory oncology (AO), or AOcpKPIs, as done in this project.¹¹

A few studies in pharmacy practice literature have effectively utilized the modified Delphi technique to develop cpKPIs.^{12,13} This project adapts the framework and methodology used by Fernandes et al. (2015), which demonstrated the successful use of the modified Delphi process to generate evidence-linked cpKPIs in acute care.¹³ Acute care cpKPIs do not fully address the unique demands of ambulatory oncology care.² Developing specialized cpKPIs for ambulatory oncology would ensure alignment with the goals of long-term patient care, adherence, and quality of life, as well as capture the holistic role of pharmacists in supporting oncology patients through complex treatment journeys.² In this study, cpKPI critical activity topics (or evidence-informed areas of focus) are defined as specific processes of care performed by pharmacists that have a significant/meaningful impact on patient outcomes.¹³ The study established a set of 8 consensus cpKPIs linked to the following 6 critical activity topics: discharge medication reconciliation, admission medication reconciliation and BPMH, interprofessional patient care rounds, pharmaceutical care, patient medication education and a proactive care bundle of specific cpKPI processes of care established in a randomized controlled trial intervention.¹³ The

consensus of these 8 cpKPIs has created a set of metrics that can be utilized to assess the quality of pharmacy practice in acute care settings.¹³ However, evidence regarding the impact of ambulatory oncology pharmacists on patient outcomes is less well-established, highlighting the need for further research in this area.⁶

In this context, the paper by Fernandes et al. (2015) highlighted several strengths that this research project sought to replicate.¹³ First, their use of a modified Delphi approach provided a systematic and iterative process, which ensured robust and credible consensus among experts.¹³ The iterative rounds, coupled with feedback, allowed for the refinement of opinions and fostered agreement.¹³ Second, the study's methodology included a comprehensive literature search to establish evidence-based candidate cpKPIs.¹³ Replicating this approach in this project will ensure that the AOcpKPIs are grounded in solid research, enhancing their relevance and effectiveness.

Third, Fernandes et al. (2015) selected a diverse panel of experts from various clinical pharmacy areas and geographical regions, ensuring that the developed cpKPIs were both comprehensive and applicable across different settings.¹³ By adopting this approach, this project aims to capture a wide range of expertise and perspectives, leading to more universally applicable outcomes. Finally, the study established clear criteria for achieving consensus, including predefined levels of agreement necessary for a cpKPI to be included.¹³ This transparency was crucial in ensuring that the results reflected collective expert agreement rather than arbitrary decisions.

By replicating the strengths identified in the Fernandes et al. (2015) study, this research project aims to increase the likelihood of developing valid, reliable, and widely accepted AOcpKPIs.¹³

To support this goal, prior research related to the current project comprised a cross-sectional survey of ambulatory oncology pharmacists in Canada to assess the need for AOcpKPIs (see figure 1 below).⁶ The survey aimed to evaluate how the impact of ambulatory oncology pharmacy practice was assessed and to gauge interest in developing AOcpKPIs specifically for this field.⁶ It collected detailed information on the availability and scope of ambulatory oncology clinical pharmacy services and summarized the participants' opinions on the need for AOcpKPIs.⁶ The survey included questions about the participating pharmacists' specialties, services provided, integration into patient care teams, and challenges faced.⁶ It covered a broad range of regions across Canada to capture potential differences in what pharmacists do between urban and rural settings and across different jurisdictions related to pharmacist scope of practice and organizational policies.⁶ The study found that while oncology pharmacists are generally involved in direct patient care, their roles and responsibilities vary widely by region and healthcare setting.⁶ Clinical pharmacy services are not uniformly available, with some regions offering more comprehensive services while others are limited.⁶ Additionally, resource limitations, such as staffing shortages and funding issues, were identified as major barriers to delivering high-quality pharmacy services.⁶ Despite these challenges, 98% of respondents supported the development of AOcpKPIs.⁶ The study suggested a need for national standards and guidelines to ensure more consistent and effective clinical pharmacy services in ambulatory oncology.⁶

The aim of the current work, initiated by a steering group of expert Canadian ambulatory oncology pharmacists, was to develop relevant AOcpKPIs to enhance pharmacy practice, as part of Phase 2 in this overall project, as shown in Figure 1.

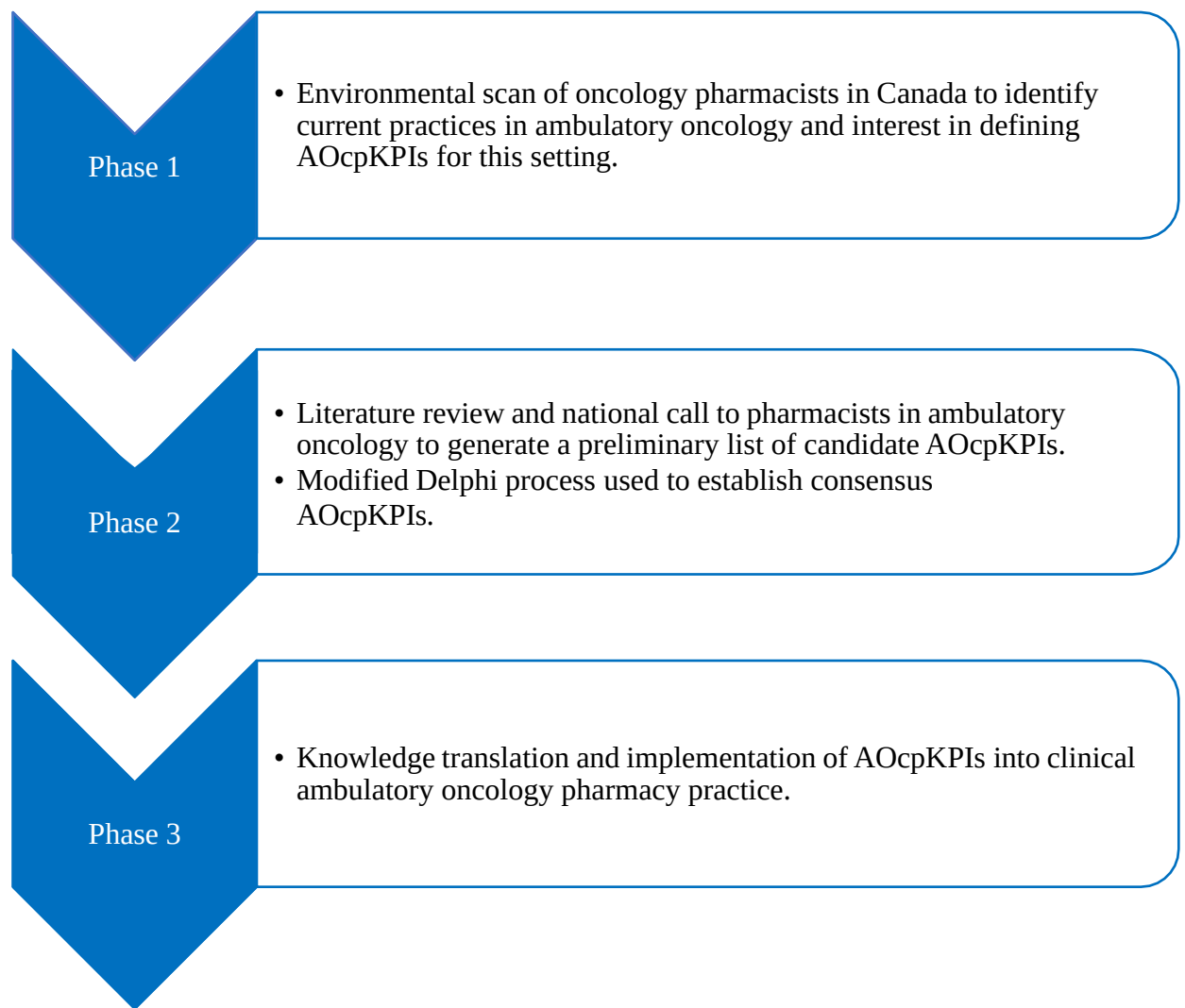


Figure 1: Three-Phase Process for Developing and Implementing AOcpKPIs

CHAPTER 2: Pre-Delphi Methodology

OBJECTIVE

The objective of this thesis was to use a consensus-based modified Delphi process with a panel of experts to identify measurable AOcpKPIs for implementation in ambulatory oncology pharmacy practice, ultimately aiming to improve patient outcomes (Figure 2).

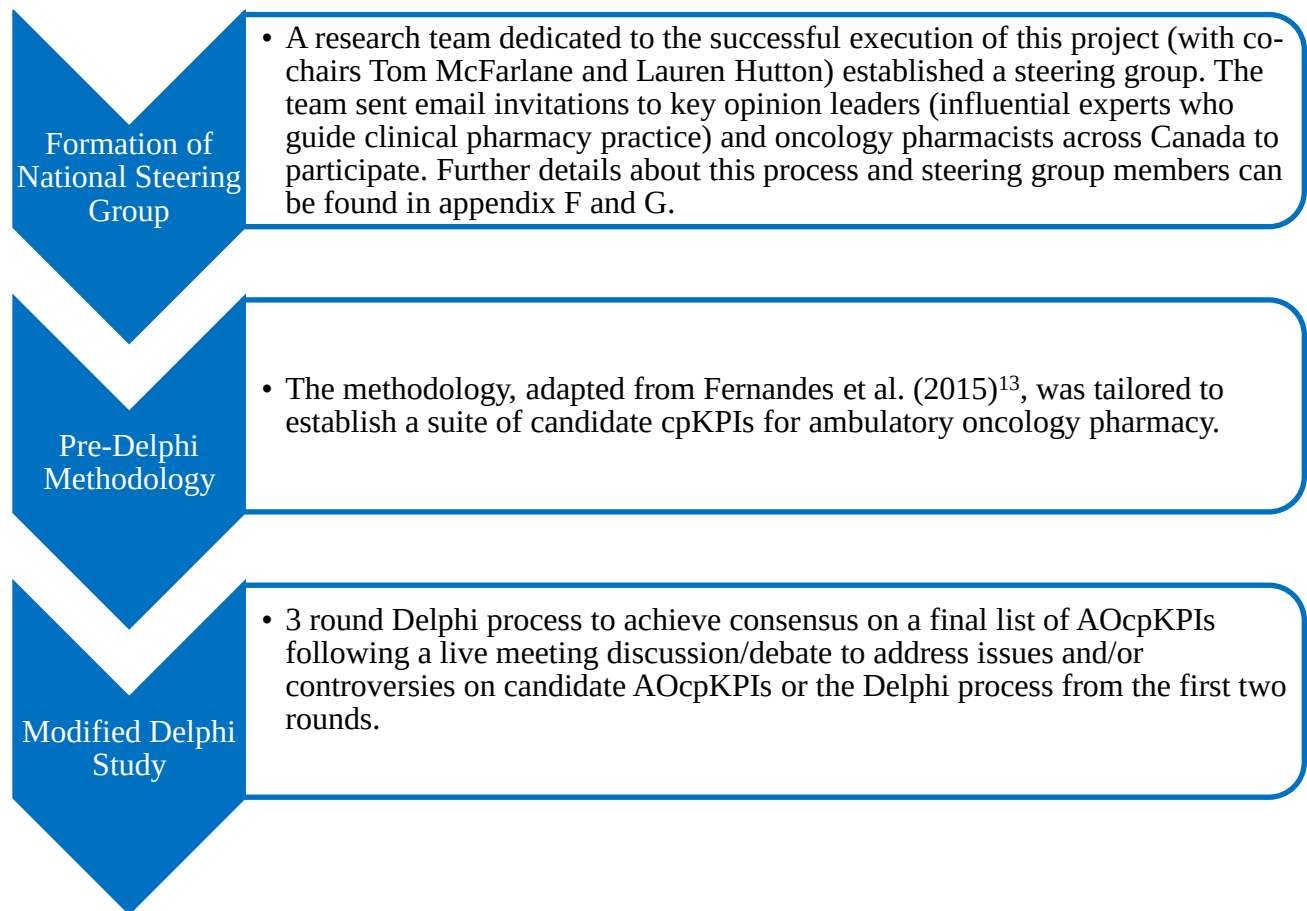


Figure 2: Overview of the Modified Delphi Process for Developing AOcpKPIs

Overall Methodology

The methodology for this project, based on the 10-step process to co-creating consensus cpKPIs for acute care, adapted from Fernandes et al. (2015)¹², was tailored to the context of ambulatory oncology pharmacy. Specifically, the following 10-step process was employed, as outlined below:

Step 1: Led by the research team, the steering group reached a consensus on a 5-point cpKPI definition (that each candidate AOcpKPI must meet) to generate candidate AOcpKPIs.

Step 2: Led by the research team, the steering group reached a consensus on 9 selection criteria (ideal attributes of health quality indicators applied to AOcpKPI) to be used to help the Delphi panel evaluate the candidate AOcpKPIs.

Step 3: A national call was distributed through the Canadian Association of Pharmacy in Oncology (CAPHO) to gather potential critical activity topics and candidate AOcpKPIs. This ensured broad inclusiveness by collecting input representative of the community of ambulatory oncology pharmacists.

Step 4a: A literature search and assessment conducted to create evidence summary tables on the impact of ambulatory oncology pharmacy practice related to existing critical activity topics.

Step 4b: Evidence summary tables were formed from the results of the literature search to be used by Delphi panelists to provide informed Likert scores in step 9.

Step 5: Identification of evidence-informed critical activity topics from evidence summary tables.

Step 6: The steering group established candidate AOcpKPIs, aligned with the predetermined 5-point cpKPI definition, from the critical activity topics based on the prevalent pharmacist interventions identified in the literature from the evidence summary tables.

Step 7: The author drafted the Delphi survey instrument using Qualtrics (Qualtrics, 2023)¹⁴, later reviewed by the research team. The survey was designed to rate each candidate AOcpKPI based on the 9 selection criteria from Step 2 followed by an overall rating using a 9-point Likert scale, with a comment box available for the panelist to explain their rationale.

Step 8a: The research team selected, recruited, and obtained consent to participate from the Delphi panelists.

Step 8b: Panelists received an education training package that included evidence summary tables, a recording of an orientation to the study, an outline of the modified Delphi process, and expectations for them.

Step 9: A three-round modified Delphi process was conducted, which included a live meeting after round two, where the research team discussed the marginal candidate AOcpKPIs with the panelists.

Step 10: The panel submitted their final rankings of the candidate AOcpKPIs in round three.

Pre-Delphi Steps (Steps 1-8b)

Step 1: Establishment of a consensus 5-point AOcpKPI definition

The steering group members first established a 5-point definition of an AOcpKPI at the beginning of the project, adapted from the study by Fernandes et al. (2015)¹⁵. A steering group meeting, organized by the research team, reached a consensus on the 5-point AOcpKPI definition, discussing the key factors that constitute an AOcpKPI in ambulatory oncology pharmacy. The original definition was modified by the steering group, changing "pharmacy/pharmacist sensitive metric" to "an ambulatory oncology pharmacist sensitive metric" to specifically target the role of the ambulatory oncology pharmacists. In addition, evidence was considered across all 4 strength-of-evidence levels defined by the Agency for Healthcare Research and Quality (AHRQ). The candidate AOcpKPIs generated during the modified Delphi process must have met the agreed upon 5-point AOcpKPI definition defined below to be included in the Delphi:

1. Reflects a desired quality practice
2. Links to direct patient care
3. Links to evidence of impact on meaningful patient outcomes. Interventions in ambulatory pharmacy (including oncology and non-oncology settings).
4. An ambulatory oncology pharmacist-sensitive metric
5. Feasible to measure

Step 2: Establishment of a consensus 9 selection criteria

During a meeting, the steering group reached consensus on 9 refined selection criteria, adapting the original 11 criteria (also known as the Slavik 11) from Fernandes et al.¹³ to ambulatory oncology pharmacy practice, which were then used to rank candidate AOcpKPIs in each round of the modified Delphi process. Table 1 below provides a side-by-side comparison of the Slavik 11 selection criteria, and the 9 selection criteria used in this project.

Table 1: Comparative Analysis of Slavik 11 and Project-Specific 9 AOcpKPI Selection Criteria

Slavic 11 Selection Acute Care cpKPI Criteria (Fernandes et al. (2015)⁶)	AOcpKPI selection criteria (established by steering group)
Based on high quality literature evidence	Based on high quality literature evidence
Relevant impact on clinically important Outcomes	Relevant impact on clinically important outcomes
Best suited to pharmacist's role	Sensitive/specific to ambulatory oncology pharmacist's contribution / scope of practice
Attributable to direct patient care	Attributable to direct patient reactive and proactive care delivery settings
Specific to pharmaceutical care process	---
Aligned with professional goals, objectives, and practices	Aligned with professional goals, objectives, and practices
Accepted disease-based quality indicator	---
Feasible to measure	Feasible to measure
Valuable quality measure	Valuable quality measure
Generalizability	Generalizability

This research study adapted the selection criterion “best-suited to the pharmacist’s role” from the Slavik 11 to “sensitive/specific to the ambulatory oncology pharmacist’s contributions/scope of practice” to specifically target the role of pharmacists in ambulatory care. Additionally, two selection criteria from the Slavik 11 “specific to the pharmaceutical care process” and “accepted disease-based quality indicator” were excluded from this project.¹³ These criteria were deemed more applicable to the AOcpKPI critical activity topics rather than the AOcpKPI selection criteria, as they pertain only to certain candidate AOcpKPIs and are not relevant to all AOcpKPIs in ambulatory oncology pharmacy.

Step 3: National call for potential critical activity topics/candidate AOcpKPIs

The author designed a poster for a national call for feedback, which was distributed online through CAPHO to gather input on potential critical activity topics/candidate AOcpKPIs.

Candidate AOcpKPIs and critical activity topic areas gathered from the national call were evaluated against the 5-point AOcpKPI definition by the steering group, with those meeting the criteria included in the Delphi process. The steering group gathered suggestions from the ambulatory oncology pharmacist community to ensure all relevant candidates were considered, including those that might have been overlooked in the literature review, while also being inclusive of the broader population of pharmacists in ambulatory oncology. Ultimately, all suggested candidate AOcpKPIs were excluded however, some suggestions aligned with the critical activity topics that were included.

Step 4a: Literature Search and Assessment

The literature search focused on targeting studies in ambulatory oncology pharmacy to gather evidence-informed pharmacist interventions linked to patient outcomes. The literature was summarized to highlight each study's design, inclusion/exclusion criteria, pharmacist intervention(s), comparator, and results, and were assigned an AHRQ outcome level (categorization of healthcare outcomes based on their relevance and the level of evidence supporting them) by the steering group. The technical details of this section are explained below and presented graphically as a PRISMA diagram in Figure 3.

Literature Search Strategy

The following search strategy was reviewed with an academic health sciences librarian and was completed on Embase and PubMed in July 2022, with the intention of making the search as specific as possible to ambulatory oncology pharmacy. All studies published up to July 2022 were searched:

intervention* AND (pharmacist* OR pharmacy OR pharmacists[mesh] OR pharmacy service, hospital[mesh]) AND (outpatient* OR ambulatory OR outpatient clinics, hospital[mesh] OR outpatients[mesh] OR ambulatory care[mesh]) AND (oncology OR cancer OR medical oncology[mesh] OR oncology service, hospital[mesh])

Inclusion Criteria

Articles selected must be in English and meet the following criteria:

- Original research papers and/or review articles
- Reported on clinical intervention studies (defined as those evaluating specific clinical interventions showing a meaningful outcome to benefit patients' health)
- Clinical interventions performed by oncology pharmacists such as participation in rounds or identification of drug therapy problems.
- Ambulatory oncology setting

Exclusion Criteria

Articles were excluded based on any of the following criteria:

- Clinical interventions focusing on dispensing rather than direct patient care
- Clinical interventions not performed by pharmacists but by other health professionals such as nurses, doctors, etc.
- Inpatient care setting
- Non-oncology patients
- Research papers published in languages other than English

Study Selection

Identified articles were imported into Covidence (web-based software platform designed to streamline the systematic review process) for screening by three researchers: Dr. Tom McFarlane (Supervisor (T.M.)), Breanna Quan (Research Assistant (B.Q.)) and the author,

Rozhannaa Sothilingam (Master's student (R.S.)). Each researcher reviewed the 599 abstracts against the predefined inclusion and exclusion criteria and discussed to reach consensus on the final list of articles, which was then shared with the steering group.

The steering group reviewed the literature review results and categorized them into AHRQ outcome levels, adapted from an AHRQ Evidence Report,¹⁶ which included:

- Level 1: Clinical and Quality of Life (QoL) outcomes (e.g., improvements seen in morbidity, mortality, or adverse events)
- Level 2: Surrogate Outcomes (e.g., improvements in blood glucose, blood pressure, cholesterol, or similar measures)
- Level 3: Measurable variables with an indirect or unestablished connection to the target outcome (e.g., how well the patient understands the medication and disease state).
- Level 4: Indirect variables (e.g., patient satisfaction or potential adverse events)

The AHRQ framework was used to organize the relevant literature by levels of reproducible patient outcomes. The steering group initially expanded the literature search to include all four AHRQ levels as they were uncertain about the availability of robust studies in ambulatory oncology, to ensure high-quality evidence for the Delphi process. Following the literature search, the group found abundant literature at levels 1 and 2 (mostly AHRQ level 2) and opted to use only evidence from these two levels to form the evidence summary tables and establish the critical activity topics.

Ambulatory Oncology Clinical Intervention Studies

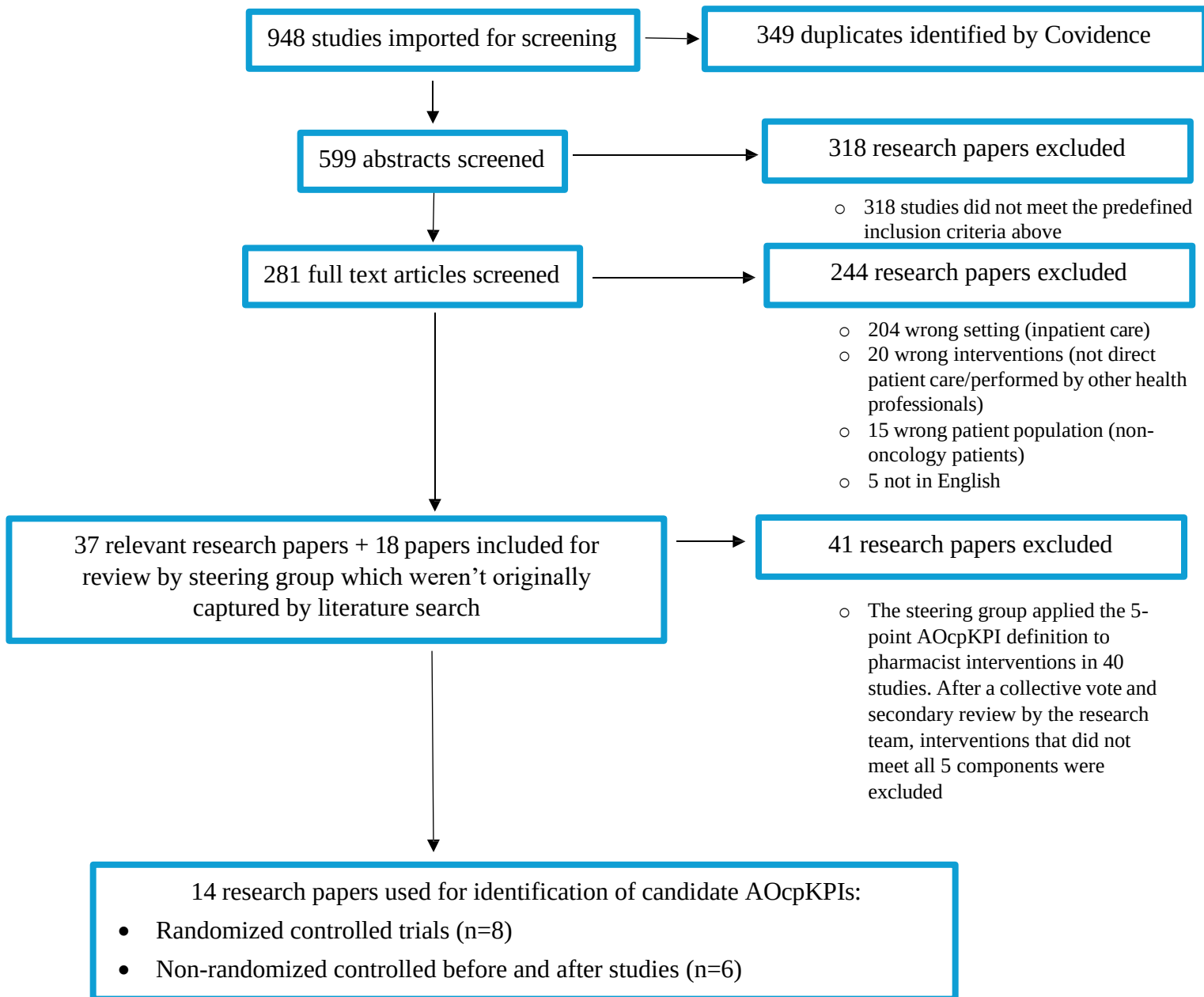


Figure 3: Literature Search PRISMA Diagram

Table 2: Literature Search Results of Ambulatory Oncology Pharmacy Studies

Author (year)	Study Design	Inclusion/ Exclusion Criteria	Pharmacist Intervention(s)	Comparator	Results	AHRQ Level Outcome
Ali et al., (2021) ³	- Institutional approved before/after study from March to July 2017 1328 patients participated in the study	- Inclusion criteria: Patients included if they were receiving chemotherapy, immunosuppressants, iron chelation therapy, or bone transplant patients - Any patients not matching above inclusion criteria excluded from the study	- Patient consultation and education - Review lab values - Manage symptoms. - Follow up interview with patients - Therapeutic drug monitoring of immunosuppressant drugs - Proactive review of chemotherapy orders for accuracy and appropriateness - Identification and management of drug-drug interactions and other drug-related problems - Respond to drug information questions from staff and patients	None	- Pharmacist conducted 240 clinical interventions to provide supportive management of chemotherapy-related complications - Pharmacist provided patient education/counseling to 110 patients where 1665 (91.5%) of interventions were accepted by the physician	Level 1 AHRQ - morbidity/mortality/QoL (quality of life)
Al-Taie et al., (2020) ¹⁷	- Randomized controlled study at an outpatient oncology centre from Oct. 2014 - July 2015 - n=56 in the intervention	Inclusion criteria: patients with diabetes newly diagnosed with cancer	- Identification of drug related problems - Assessment of adherence to patient's diabetes medications	None	Patients in the control had higher mean fasting blood glucose levels (185.08 (baseline) vs. 144.18 mg/dL,	Level 2 AHRQ- HgB A1C would be considered a surrogate outcome for

	- group and n=53 in control group. - The mean age for the control group was 63 years old (SD (Standard Deviation) =8.24 years) and 61 years old (SD=8.99 years) for the intervention group.	Any patients not matching above inclusion criteria excluded from the study	- Provision of counseling - Recommendations on drug dosage, frequency, administration		- p=0.083) compared to the intervention group (155.1(baseline) vs. 128.98 mg/dL, p=0.169) - Significant decrease in HbA1c in intervention group (6.8% vs 6.0%, p=0.049) compared to the control (6.6% vs. 7.5%, p=0.036)	diabetes related morbidity.
Ashjian et al., (2015) ¹⁸	- Evaluation of outpatient medication reconciliation from Jan. to Dec. 2013 - n=510 patients - Mean age 60 years old	- Inclusion criteria: included all patients aged 18 years old and higher who has completed a medication reconciliation with student pharmacist preceptor team between the duration of Jan 1, 2013- Dec 31, 2013 - Any patients not matching above inclusion criteria	- Medication reconciliation was done by student pharmacists for hematology/oncology patients who received parenteral chemotherapy without a physician which was then reviewed by pharmacist preceptor. - A natural medicine comprehensive database was used by the student pharmacists to screen current medications patients were on for drug-drug interactions. The results found by	None	- Student pharmacist identified at least one or more discrepancies in 88% of patients (reviewed by pharmacist preceptor). - Student pharmacist identified medication related problems in 11.4% of patients (reviewed by pharmacist preceptor).	Level 1 AHRQ - morbidity/mortality/QoL

Battis et al., (2017)¹⁹

	excluded from the study	the student pharmacist was discussed with the pharmacist preceptor which included any discrepancies/issues found by student pharmacist during medication reconciliation.			
- Monitoring clinic held from Sept. 2014 – Apr. 2015 - n= 68 patients - Mean age 72 years old - Scheduled follow-ups were made by the pharmacist to monitor adherence to oral chemotherapy medications	- Inclusion criteria: patients taking different oral chemotherapy agents for therapy - Any patients not matching above inclusion criteria excluded from the study	- Follow ups every two weeks for 2 months for patients new to chemotherapy and once a month for patients who have been on chemotherapy - Medication reconciliation - Ordering labs for drug therapy monitoring - Preventing drug adverse events from medication reconciliation during scheduled follow up appointments - Providing supportive care - Providing appropriate referrals - Sharing patient progress	None	- DRPs (Drug related problems) identified for 31 patients (45%) 7.3% of medication related orders contained an error in patients' medication regimen identified - A follow up with pharmacist was scheduled to monitor adverse drug reactions of intervention group	Level 1 AHRQ - morbidity/mortality/QoL

			information with physicians			
			• Patient counseling on adherence			
Caracuel et al., (2014) ²⁰	• 4-month longitudinal prospective intervention study • Before/after study where pharmacist reviewed patient's antiemetic regimen. • n=69 patients in control group, n=33 in the intervention group. • Mean age 59 years old	• Inclusion criteria: adult patients attending oncology day unit and starting a new IV chemotherapy treatment • Exclusion criteria: patients' treatment that included minimal emetic chemotherapy risk and on corticoid treatment	• Reviewing antiemetic protocol • Patient education • Explanation of importance of treatment to patients • Drug dose adjustment	• proactive vs reactive care	• There was a non-significant difference between the control and intervention group in self-reported adherence increased in the intervention group 76% compared to the control being 59% (ARR (absolute risk reduction) 17%; 95% CI (Confidence Interval) – 5 to 34); p=0.127 • The control group had 22% of the participants take their medication earlier than administered	• Level 2 AHRQ surrogate outcome – (surrogate for morbidity and QoL)
Cataldo et al., (2022) ²¹	• 6-month prospective study at an outpatient pharmacy associated with a tertiary level cancer hospital • n=27 patients • Mean age 57 years old	• Inclusion criteria: 18 years of age or older treated with tamoxifen, anastrozole, etoposide,	• Identification and management of drug related problems • Advice on health care • Explanation of correct indication	• None	• Clinical pharmacist identified 133 drug related problems (4.71/patient) where 33% were related to their oral chemotherapy regimen	• Level 1 AHRQ - morbidity/mortality/QoL

Chew et al., (2015) ²²		• ormegestr ol • Any patients not matching above inclusion criteria excluded from the study	• Referral to other health professionals • Identification and management of adverse drug reactions • Correct administration of drugs ensured • Patient education		• Of the 78 pharmacist interventions 96% were accepted by the physician • Non-adherence was the most reported drug related problem (16%)	
	• Prospective interventional study at a national cancer center in Singapore from Sept. to Nov. 2012	• No exclusion or inclusion criteria	• Identification and management of drug related problems • Identification and management of adverse drug reactions • Symptom management	• None	• 184 drug related problems were identified where the most common pharmacist intervention reported was related to chemotherapy agents (76%) and premedication (12%) • The reason for making an intervention was due to clarification of medication order (33%) followed by inappropriate dose (29%)	• Level 1 AHRQ - morbidity/ mortality/QoL
Delaney et al., (2009) ²³	• Feasibility study at a neurooncology clinic from Nov. 2007 – Feb. 2008 • n=13 patients, age range 45-67 years old	• No exclusion or inclusion criteria	• Pharmacist met with patients in the study at an initial clinical visit followed by telephone follow up twice afterwards. Follow-up	• None	• A survey was developed by pharmacists in the study and distributed to patients and staff to assess their satisfaction with	• Level 4 AHRQ - measurable variables with indirect connection to outcome

		included: patient education, management of side effects and monitoring of adherence to patients' treatment therapy • Activities: • Attending weekly multidisciplinary patient rounds • Communication with the hospital dispensary • Counselling patients and addressing drug information questions • Collect medication history • Monitor lab results and therapeutic drug levels • Provide information on chemotherapy administration including dose and time of treatment, side effect management, dosing of supportive medications		pharmacist interventions • 90% of patients, doctors, nurses, reported that the clinical pharmacist was a useful member of the neurooncology team. • Healthcare team reported the pharmacist improved patient compliance, side effect management and quality of life.	
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Edwards et al., (2014)²⁴

		• Identification and management of drug interactions			
• Randomized controlled trial in a hospital setting of 200 patients (n=100 in intervention group, n=100 in control group)	• Patient inclusion criteria: - ≥ 19 years of age - Prescribed parental chemotherapy - Capable of completing treatment diary and quality of life questionnaires • Any patients not matching above inclusion criteria excluded from the study	• Medication history review • Medication reconciliation • Interview and phone follow-up • Identification and management of DRPs • The seamless care pharmacist followed-up with patients' community pharmacy via phone and resolved drug related problems. • Seamless care identified as "the continuity of pharmacist care to a patient in a health care system across the spectrum of caregivers and their environments. Pharmacist care is carried out such that when one pharmacist ceases to be responsible for a patient's care another pharmacist/health care professional accepts	• proactive vs reactive care	• The seamless care pharmacist identified on average 2.6 DRPs in metastatic patients vs. 4.1 in adjuvant patients (p=0.037)	• Level 1 AHRQ - morbidity/mortality/QoL

			responsibility of the patient's care".			
Farias et al., (2016) ²⁵	- Interventional before/after study in a Brazilian tertiary teaching hospital from Nov. 2013 to Nov. 2014 and Nov. 2014 to Nov. 15 - n=67 patients in intervention group and n=54 in control	- Inclusion criteria: inpatients and outpatients with hematological diseases, males only - Any patients not matching above inclusion criteria excluded from the study	- Identification and management of medication related problems - Dose adjustment - Suspension of medication - Alteration of diluent/concentration of compounded medications - pharmaceutical care plan - Changing frequency of medication - Alteration of route of administration	proactive vs reactive care	- Patients with medication related problems (MRPs) with underlying diseases including: non-Hodgkin lymphoma (NHL), multiple myeloma (MM) and acute lymphoid leukemia (ALL). - Significant increase in MRPs in patients with NHL (p<0.001) and even higher increase in MRPs seen in patients with MM (p=0.068)	Level 1 AHRQ - morbidity/mortality/QoL
Fujii et al., (2022) ²⁶						

		Any patients not matching above inclusion criteria excluded from the study	post pharmacist intervention.		5 indicates a severe problem. - The Wilcoxon signed-rank test was used to evaluate the effect of pharmacist interventions on patients' quality of life - Quality of life significantly improved (EQ-5D-5L values of 0.8197 prior to intervention vs. 0.8603 post intervention; $p < 0.01$) - Nausea and vomiting significantly improved (EQ-5D-5L values of 0.8145 prior to intervention vs. 0.8603 post intervention; $p = 0.016$)	
Jackson et al., (2019) ²⁷	- Pilot study of collaborative drug therapy management from Oct. 2016 – Jan. 2017 - n=45 pharmacist consults	Inclusion Criteria: Patients included those diagnosed with chemotherapy-induced nausea or vomiting (CINV)	- Patient education - Recommended EKG (electrocardiogram) monitoring - Addition or discontinuation of medication - Changing dose/duration/frequency of medication	None	188 clinical interventions performed which included but were not limited to: addition of new medications (37%), patient education (34%) and discontinuation of medications (10%)	Level 2 AHRQ - surrogate outcomes (i.e., heart rate/blood pressure (HR/BP))

	Any patients not matching above inclusion criteria excluded from the study	- Adding hydration - Adding bowel regimen - Completing a prior authorization - Medication reconciliation - Diet modifications - Adding acid suppression therapy - Recommendation of additional labs/tests - Modifying pain regimen		- Patients showed improvement in symptoms such as in the severity of acute nausea, the number of delayed vomiting episodes and severity of delayed nausea. - Patients were asked to report their symptom score in a questionnaire before and after pharmacist intervention on a 10-point scale where 0 represented no nausea or vomiting and 10 represented worst nausea or vomiting. - Patients reported 8 on the 10-point scale for acute nausea before pharmacist intervention and 0 after pharmacist intervention. - Patients reported 4 on the 10-point scale for delayed vomiting before pharmacist intervention and 0 after pharmacist intervention.	
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Kaya et al., (2021)²⁸

				Patients reported 10 on the 10-point scale for delayed nausea before pharmacist intervention and 0 after pharmacist intervention.	
Retrospective analysis of clinical pharmacy services provided by oncology vs. non-oncology pharmacists for outpatients from Jan. – Dec. 2016	No exclusion or inclusion criteria	- Services performed by oncology pharmacists, including: - Identification and management of ADRs (adverse drug reactions) - Recommended change in treatment, dosage, or duration to physician - Management of symptoms	None	1,177 services provided by oncology pharmacists vs. 1,050 by non-oncology pharmacists (p<0.001) - Adverse drug reaction improvements accepted by the physician were significantly higher in those suggested by an oncology pharmacist 14.4% (170 adverse drug reaction improvement interventions accepted by physician /1177 clinical pharmacy services) than non-oncology pharmacist 8.2%	Level 2 AHRQ - surrogate outcomes (i.e., HR/BP)

Kimura et al., (2017)²⁹

				(86 adverse drug reaction improvement interventions accepted by physician /1050 clinical pharmacy services) (p <0.001)	
- Randomized controlled trial of an outpatient pharmacist service from Sept. 2012 – Mar. 2016 - n=33 in the intervention group, n=37 in the control group with s-1 adjuvant chemotherapy. - Age range 37-83 years old	No exclusion or inclusion criteria	- Assessment of adherence and adverse events - Supportive care (drug therapy for adverse events) - Telephone consultation - Monitoring side effects - Drug information and recommendations - Creating a pharmacy service record	proactive vs reactive care	The frequency of adverse drug events was greater in control compared to the pharmacist intervention group. 26 (70.3%) in control group (CG) vs 15 (45.5%) in pharmacist intervention group (PG) p=0.0311) Relative Dose Intensities (RDIs) between the control and pharmacist intervention group was not significantly different (82.9% vs. 84.7%, p=0.2942)	Level 2 AHRQ - surrogate outcomes (i.e., HR/BP)
- Prospective study at a tertiary hospital - n=75 patients in the study - The mean age was 59 years old	No exclusion or inclusion criteria	Systematic analysis to detect clinically significant interactions (CSI)	None	20 cases of CSIs (clinically significant interactions) identified where the drug was modified/discontinued	Level 1 AHRQ - morbidity/mortality/QoL

Lopez-Martin et al. (2014)³⁰

Maleki et al., (2019) ³¹	(SD 13.9 years old)		- Interventions included: - Withdrawal of drug while patient was receiving chemotherapy - Supportive therapy - Medication reconciliation - Alternative medication therapy - Communication with physician for treatment modification		nued to resolve the ADRs 94% of pharmacist recommendations were accepted by the physician	
	Systematic review	- Inclusion Criteria: - Original full text articles published between 2007-2017 - Evaluated outpatient pharmacy services - Served adult population with cancer - Reported at least one change over time - Reported at least one medication related outcome	- Medication reconciliation - Patient education - Adherence assessments - Economic appraisal - Identification and management of DRPs - Supportive medication adjustment - Assessing and managing drug-drug interactions - Drug dose optimization - Identification and management of symptoms	proactive vs reactive care	- There were 5 studies that measured adherence in patients where 2 out of the 5 studies showed results that were significant to mention: - Ribed et al. study showed a significant improved in medication adherence in 20% of the patients in the study (249); p<0.001. - In Walter et al., study medication adherence was measured by looking at the difference in	Level 1 AHRQ - morbidity/mortality/QoL

	Any patients not matching above inclusion criteria excluded from the study			responses in an adherence assessment provided to patients. The question “Do you ever forget to take your medicine” was asked to patients by which 23 patients reported yes and 23 patients reported no prior to pharmacist intervention. Post pharmacist intervention 9 patients reported yes and 37 reported no (p <0.001) The most significant improvement seen in symptom management was in a study looking at patients with breast and ovarian cancer. The intervention group in this study got an emesis response rate of 92% compared to 49% in control; p<0.001	
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17. Maleki et al., (2022) ³²	- Single centre prospective parallel randomized controlled trial in an outpatient multidisciplinary radiotherapy clinic - n=59 in the intervention group, n=56 in the control group - Mean age 60 years old	No exclusion or inclusion criteria	- Pharmacist-led pharmaceutical care program including: - Assessment of symptom burden - Assessment of adherence to medications - Adjustment of medication dosages - Control of symptoms	proactive vs reactive care	- Patients assigned a Medication Understanding and Use Self-Efficacy (MUSE) score from 8 (minimum) to 32 (maximum) used to measure patient adherence and ability for patients to teach back. - The median IQR (Interquartile range MUSE score at baseline was 29.5 (24.0,32.0) in the control group and 30.0 (27.0,32.0) in the intervention group. The median (IQR) MUSE score after pharmacist intervention was 27.0 (22.5,32.0) in the control group and 31.0 (28.0,32.0) in the intervention group. - Patients' MUSE higher in the intervention group compared to the control with a difference of 2.70 (CI: 1.24, 4.17)	- Level 2 AHRQ-surrogate outcomes (i.e., HR/BP) - Level 3 AHRQ-measurable variables with indirect or unestablished connection to outcome (i.e., medication disease state knowledge)
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					- The Edmonton Symptom Assessment Scale (ESAS) was used to measure well-being of patients. The ESAS uses a 10-point Likert scale where 0 represents absence of symptom and 10 represents worst possible severity. - Patient well-being 1.25 (95% CI: -2.24, -0.27) in intervention group vs. 0.52 (95% CI: -1.03, -0.01) in control group	
Mancini et al., (2012) ³³	- Review of first 75 patients seen by an oncology pharmacist at a multidisciplinary supportive oncology clinic (study dates not provided) - Patient survey to evaluate their experience with the pharmacist	No exclusion or inclusion criteria	- Access to medication (ability of patient to afford medication) - Assessment of adherence to medication - Medication reconciliation - Patient education - Evaluation of drug interactions, side effects, lack of efficacy and untreated conditions	proactive vs. reactive care	The findings during the pharmacy assessment revealed 40 patients (53.3%) reported cost issues as a barrier to retrieve their medication, 15 patients (20%) reported transportation issues as barrier to retrieve their medication, and 24 patients (32%) reported access to health care as a barrier which included	Level 1 AHRQ - morbidity/mortality/QoL

					trouble getting refill authorization. 47 patients (62.7%) reported missing at least 1 dose of their scheduled medication due to forgetting, confusion as a side effect of taking the medication and lack of wanting to take to take the medication.	
Mauro et al., (2019) ³⁴	- Prospective 1:1 randomized single-site, single-blinded study with 6 months follow-up - n=32 adult patients 16 participants in intervention group and 16 in control group	- Inclusion criteria: adult patients treated with lenalidomide - Any patients not matching above inclusion criteria excluded from the study	- Telephone follow- up - Assessment of adherence and encouragement of adherence during follow up appointments	proactive vs reactive care	- Adherence 100% among intervention group vs. 87.4% in control group (p=0.001) - The intervention group took a greater proportion of doses within the 2-hour administration window (83% vs. 22% among controls); p<0.001	Level 2 AHRQ - surrogate outcomes (i.e., HR/BP)
Mashni et al., (2022) ³⁵	Retrospective study at a chemotherapy inclusion clinic at a cancer teaching hospital from Jan. 2015 – Dec. 2019	- Inclusion criteria: patients diagnosed with cancer were assessed - Any patients not	- Assessing chemotherapy orders - Evaluating eligibility of patients with chemotherapy to determine	None	1445 adverse drug events were identified by the clinical pharmacist where ≥50% of interventions were changes in prescribed doses	Level 1 AHRQ - morbidity/ mortality/QoL

Meleis et al., (2020)³⁶

	matching above inclusion criteria excluded from the study	therapeutic appropriateness • Patient education • Identifying and assessing adverse events • Supportive care • Dose changes • Drug therapy additions • Drug therapy discontinuation • Preventing allergies • Delay treatment as an action to manage adverse drug events until appropriate plan is determined		or addition/discontinuation of medication • 22% of ADRs were hematologic and 20% were infusion related • the effect of pharmacist interventions in chemotherapy ambulatory settings	
• Single center retrospective descriptive study from July-December 2015 • n=3,967 ambulatory oncology patients	• No exclusion or inclusion criteria	• Writing chemotherapy orders/plans • Adjusting medication regimens based on lab results, vitals, side effects • Symptom management • Identification and management of adverse drug events • Drug-drug interaction support • Patient education/counseling	• None	• 93% of surveyed nurses and physicians agreed that the clinical pharmacist was an essential part of the multidisciplinary healthcare team • Most frequently documented pharmacist intervention was treatment plan management (25%) followed by pharmacotherapy interventions (24%) and	• Level 1 AHRQ - morbidity/mortality/QoL

					patient education (21%)	
Nishibe-Toyosato et al. (2021) ³⁷	- Non-randomized before and after discharge study - Data collection between Dec. 2007-Mar. 2019 - n=18 in intervention group, n=15 in control group	- Inclusion Criteria: Included patients who received erlotinib treatment for more than 6 months - Any patients not matching above inclusion criteria excluded from the study	- Pharmacist consultation 2 months after treatment including: - Drug information (prescription proposal to physician) - Monitoring	None	- The intervention group had a significantly higher median RDI which was (97.6% [78.1-100.0] RDI compared to control (71.4% [56.3-85.9]) (p=0.0437) - The intervention group had a longer progression free survival (PFS) of 547 days vs. 305 days in control (p=0.119).	Level 2 AHRQ- relative dose intensity of erlotinib helps maintain systemic exposure of drug which is linked to improved treatment outcomes (morbidity/ mortality)
Oliveira et al. (2021) ³⁸	Systematic review	- Inclusion criteria: - Patients with hematological cancer at an oncology center - Pharmacotherapeutic monitoring by pharmacists - Original research articles published	- Assessment of adherence to medications - Identification of drug related problems - Identification of improper administration - Management of adverse events - Medication consultation - Identify and address barriers to adherence - Addition of drugs	Proactive vs. reactive care	17 studies identified comprising 4771 patients with an average follow up time of 15.3 months - In Farias et al., 2016 study the involvement of pharmacist intervention there was a 106% increase in detection of drug related problems in 185 patients in the study	- Level 2 AHRQ: Patient adherence: -Lam MS and Cheung N. Impact of oncology pharmacist managed oral anticancer therapy in patients with chronic myelogenous leukemia. J Oncol Pharm Pract 2016; 22:741-748.). -Ribed A, Romero-Jimenez RM, Escudero-Vilaplana V, et al.

		- between 1999-2019 Published in Portuguese, Spanish or English • Exclusion criteria: - Did not consider treatment of onco-hematologic tumors - Literature reviews and case studies	• Discontinuation of medication • Dose adjustment • Lab monitoring • Adjusting pain control regimens • Alternative/complimentary therapies		• In Chen, Wu and Huang 2019 study the involvement of clinical pharmacist intervention led to decreased hospitalization time from 19.27 to 16.69 days where 826 pharmacist interventions were completed ($p < 0.00001$)	Pharmaceutical care program for onco-hematologic outpatients: safety, efficiency, and patient satisfaction. Int J Clin Pharm 2016; 38: 280–288.
Patel et al., (2016) ³⁹	• Cohort analysis comparing two historical cohorts n=31 patients • control cohort n=14 and intervention cohort n=17	• Inclusion criteria: patients receiving abiraterone, bicalutamide or enzalutamide for treatment of metastatic castrate-resistant prostate cancer after the implementation of that pharmacist led oral chemotherapy program	• Address adherence • Address drug-drug interactions • Alter therapy • Assist with cost issues • Manage adverse events • Provide drug information	• Proactive vs. reactive care	• This study compared 2 cohorts of patients who received abiraterone, bicalutamide or enzalutamide for metastatic castrate-resistant prostate cancer treatment. The number of pharmaceutical interventions and adherence were measured in the control group and intervention group. The adherence and number of pharmaceutical	• Level 2 AHRQ - surrogate outcomes (i.e., HR/BP)

	Any patients not matching above inclusion criteria excluded from the study			interventions in the intervention group was measured 24 months post the pharmacist-led oral chemotherapy monitoring program - A significant difference seen in the number of average pharmaceutical interventions per patients (6.9 in intervention cohort and 2.6 in control cohort, (p=0.004) - A significant difference seen in the number of pharmaceutical interventions that addressed adherence (31 in intervention cohort and 4 in control cohort, (p=0.018) - Increase in the number of average pharmaceutical interventions made per patient 6.9 vs 2.6 in control (p=0.004) & adherence to lab parameter monitoring 10 vs	
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Patel et al. (2017)⁴⁰

				3 in control (p=0.04) • Probability of continued treatment of intervention group 83% vs. 48% among control group (p=0.019)	
• Prospective interventional study from July 2013 - June 2016 at an academic oncology care setting • n=1362 patients in study (number in intervention and control groups not specified)	• No exclusion or inclusion criteria	• Identification and resolution of medication-related problems (MRPs)^b: • Inappropriate medication • Untreated indication • Wrong dose calculation • Sub-therapeutic dose • Drug-drug interactions • Drug duplication • Failure to receive drug • Overdose/unsafe dose • Safety monitoring • Advising on administration guidelines	• None	• Common MRPs: lack of supportive care (n=244), inappropriate administration (n=198), drug-drug interactions (n=158) • MRPs resolved by pharmacist through change in treatment (14.8%), monitoring (12.7%) and providing supportive care (18.6%)	• Level 1 AHRQ - morbidity/mortality/QoL

Patel et al. (2019)⁴¹

• Prospective observational single centre study at a private specialty oncology care hospital • Study period July 2013 - June 2016 • n=1328 patients in study (did not describe number in intervention vs. control groups)	• No exclusion or inclusion criteria	• Caregivers interviewed to identify possible adverse drug reactions (ADRs)^a • All ADRs reported in the patient's file in the first year was assessed with the pharmacist and physician • Educational interventions by pharmacist: • Structured educational interventions to nurses • Therapeutic/educational interventions to physician • System-based interventions to hospital administration	• None	• 81% of ADR were reduced in years 2 and 3 to 46% and 34%, respectively • Common ADRs: • Inappropriate anti-emetic regimen (n=64) • Lack of supportive care (n=60) • Inability of physician to provide counselling (n=32)	• Level 1 AHRQ-morbidity/mortality/QoL
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Quinn et al. (2022)⁴²

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		Any patients not matching above inclusion criteria excluded from the study	- Scheduling of breakthrough antiemetic - Extended dexamethasone duration - Dose escalation of previously prescribed antiemetic - Medication counselling - Adherence counseling		nausea and vomiting were provided a grade which used the National Cancer Institute (NCI) Common Terminology of Criteria for Adverse Events (CTCAE) version 5. - Most common interventions were medication counselling (21) and addition of a prophylactic medication (21). Least common intervention was dose escalation of previously prescribed antiemetic (3) - pharmacist led program to see the effect of pharmacist intervention on the management of refractory CINV patients	
Ribed et al. (2016) ⁴³	- Before and after discharge study in a Spanish tertiary hospital - Control group was patients starting treatment in 2011, intervention was patients starting treatment in 2013	Inclusion Criteria: - Starting oral chemotherapy - Diagnosed with onco-hematologic tumor	- Reinforcement of patient education and literacy - Provision of information on co-administration with other drugs/herbal meds and	No pharmacist intervention	169 drug-related problems (DRP) identified in intervention group vs. 106 in control (p=0.008) and decreased during follow-up where 186 DRPs detected at baseline	Level 2 AHRQ - surrogate outcomes (i.e., HR/BP)

	n=152 in intervention group, n=131 in control group	Any patients not matching above inclusion criteria excluded from the study	- administration with meals - Recommendation of dosage modification to physician - Monitoring for 6 months after discharge - Identification and resolving adverse effects		- compared to 64 DRPs after completion of 1 month of treatment and reduced further to 25 DRPs after completion of 6 months of treatment. - After 6 months, 80.8% adherence among intervention group vs. 60.5% in control (p<0.001)	
Riu-Viladoms et al. (2019) ⁴⁴	- Descriptive prospective study in a tertiary care teaching hospital - n=219 patients (age range 33-89 years old)	- Inclusion Criteria: seen by an oncologist/haematologist and prescribed oral antineoplastic treatment - Any patients not matching above inclusion criteria excluded from the study	- Assessment for interactions or contraindications prior to receiving oral antineoplastic drug - Addressed drug-drug & food-drug interactions through: - Drug suspension - Drug changes - Changes in schedule - Drug substitution	None	736 concomitant medications were registered among the study sample, and 34 drug-drug/food-drug interactions were reported 19 of 34 interactions were resolved by the pharmacist - the effect of pharmacist intervention on patients receiving oral antineoplastic drugs	Level 1 AHRQ - morbidity/mortality/QoL
Sebring et al. (2020) ⁴⁵	Single-center retrospective chart review of patients at a cancer hospital	- Inclusion criteria: - Age ≥18 years old - Admitted or discharged	Pharmacist-led comprehensive chemotherapy consultation service consisted of pharmacist	proactive vs reactive care	Adherence within 1 month after discharge was 98.0% among intervention group vs. 92.3%	Level 3 AHRQ - measurable variables with indirect or unestablished connection to outcome (i.e.

	from Apr. 2014 – Oct. 2017 - Inpatient stay >48 hours - First cycle of chemotherapy received during admission - n=36 in intervention group, n=72 in control - Two control patients who received oncology care at North Carolina Cancer Hospital (NCCH) prior to the implementation of pharmacist-led comprehensive chemotherapy was included in the control group for every 1 intervention patient in the intervention	follow up with outpatients for adherence consultation on chemotherapy treatments.		in the control group (p=0.0018)	medication disease state knowledge)
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Suzuki et al. (2020)⁴⁶

	group of this study. Any patients not matching above inclusion criteria excluded from the study				
- Retrospective evaluation of thyroid cancer patients from May 2015 - March 2017 - n=24 patients. Age range 44-83 years old	- Inclusion criteria: patients receiving Lenvatinib oral targeted therapy - Any patients not matching above inclusion criteria excluded from the study	- Telephone follow up - Identified and managed drug related problems - Discussed problems with oncologist and decided to continue observation with no medical intervention - Assessed discontinuation of Lenvatinib - Supportive medication for adverse drug reactions	None	- Pharmacist telephone follow-up service resulted in 69 calls to be managed and 18 calls where problems were confirmed with oncologist with no further medical intervention - Misuse events was identified in 17% of patients by the pharmacist and resolved over phone - effect of pharmacist interventions alongside an oncologist in patients with thyroid cancer	Level 2 AHRQ - surrogate outcomes (i.e., HR/BP)

Uchida et al. (2022)⁴⁷

• Multicentre prospective observational study of 1 month duration in Sept. 2018 • Included 28 pharmacists from 28 community pharmacies in Japan • common age group was 70+ years old • cancer was most common disease • 44 patients had more than one disease • Inclusion criteria: 28 community pharmacists that are members of the Japanese Society of Pharmacists for Palliative care that showed interest participated in this study • Outpatients that visited any of the 28 community pharmacies in this study and homebound patients that pharmacists visited were included in this study	• Inclusion Criteria: outpatients who visited the pharmacy and patients who received visits from the pharmacist at home • Any patients not matching above inclusion criteria excluded from the study	• Documenting comorbidities • Adverse effects assessed by pharmacist to see if effects were improved by deprescribing • Identification of inappropriate drugs • Medication counselling • Prescription audit (medication review) • Identification of duplication of pharmacologic effect • Identification and resolution of drug-drug interactions • Telephone follow-up	• None	• Adverse effects avoided from pharmacist recommendation in patients: sleepiness/sedation (2 pharmacist recommendations given), constipation (2 pharmacist recommendations given), gastrointestinal disorders (1 pharmacist recommendation given), dermatitis (1 pharmacist recommendation given) and cognitive function (2 pharmacist recommendations given) • Inappropriate prescriptions identified during counselling (n=48), audits (n=30) and telephone follow-up (n=25) • effect of pharmacist intervention aimed at discontinuing inappropriate drugs/ dose of drugs	• Level 1 AHRQ-morbidity/mortality/QoL
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Virani et al., (2020) ⁴⁸	- Retrospective analysis at a medical center from Aug. 2018 – Nov. 2018 - n=100 patients	No exclusion or inclusion criteria	- Discharge prescription review - Medication reconciliation - Pain therapy management - Management of adverse drug events - Antiemetic therapy management - Chemotherapy order management - Discharge education - Dose adjustment - Drug information consult - New therapy recommendation	the clinical and financial effect of oncology pharmacists in an interdisciplinary clinic vs no pharmacist interventions	- n=474 interventions, most commonly patient education (n=97) resulting in a total cost savings of \$113,101 - Pain management by the pharmacist held the highest dollar cost savings of \$33,000 13% of the interventions were medication reconciliation with a cost savings of \$76,340	Level 1 AHRQ - morbidity/mortality/QoL
Yamada et al. (2018) ⁴⁹						

					and 14 reported average pain after pharmacist intervention. • Significant difference in the pain score at first occasion (before pharmacist intervention) where 15 patients reported severe/worst pain compared to the pain score reported by patients at the third occasion where 7 patients reported severe/worst pain ($p=0.010$) • Significant difference in the pain score at first occasion (before pharmacist intervention) where 20 patients reported moderate/average pain compared to the pain score reported by patients at the third occasion where 7 reported moderate/average pain ($p<0.001$) • Physicians accepted 85.4% of pharmacist recommendations	
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Zhang et al. (2021) ⁵⁰					the effect of pharmacist intervention in outpatients with opioid treatment for cancer pain	
	- Randomized controlled trial - n=100 patients (n=51 intervention, n=49 control) enrolled for 4 weeks	No exclusion or inclusion criteria	- Completion of 24-hour pain diaries, ADR form every 3 days and BPI (Brief Pain Inventory) form every 15 days - Review ADRs - Review medication adherence - Change drug/dosage if needed - Propose pharmacologic interventions to physician - Provide patient education	Proactive vs. reactive care	- Pain intensity was measured using a pain scale from 0 to 10 where 0 indicated no pain and 10 indicated very severe pain. The baseline for the intervention group was 4 vs 7 for the control. After pharmacist intervention this was reduced to 1 for the intervention group and 2 for the control (p=0.001) - Adherence increased in intervention group from 43% to 63% compared to the control group which increased from 33% to 51% (p<0.001) - effect of pharmacist intervention along with	Level 1 AHRQ - morbidity/mortality/QoL

Zhao et al. (2021) ⁵¹					physician intervention to provide better management of ambulatory patients with cancer	
	- Descriptive prospective study at a tertiary teaching hospital from June 2018 – June 2020 - n=216 patients	- Inclusion criteria: patients with malignant tumors included in study (mean age 52 years) - Any patients not matching above inclusion criteria excluded from the study	- Medication therapy review - Identification of DRPs - Advice related to dosing and chemotherapy regimens - Monitoring and management of ADRs - Supportive care - Review and order of lab tests - Patient education and adherence counselling - Comorbidities management and referral 2-3 follow-up via phone and in person per patient with pharmacist when drug related problems needed to be addressed such as non-adherence, new	None	316 DRPs identified, of which 133 were due to adverse drug reactions and resolved by the pharmacist 90.3% of pharmacist recommendations were accepted by patients/physicians - effect of pharmacist intervention on ambulatory neoplasm patients	Level 2 AHRQ - Assessing adverse reactions – surrogate outcome for QoL and potentially morbidity

Suzuki et al. (2019) ⁵²			adverse reactions or lab values falling out of normal range. • Patient interview to assess outcome of DRPs			
	- Retrospective cohort study from June – Aug. 2016 - n=63 patients 20 male and 43 female patients - Median age of 70 years old (range=36-85 years old) - Study involved 6 outpatient pharmacists that worked at the outpatient clinic	- Inclusion criteria: patients who received outpatient chemotherapy through a pharmacist collaboration service at an outpatient clinic between the dates June-August 2016 - Any patients not matching above inclusion criteria excluded from the study	- Identification and management of ADRs - Provided supportive medications to manage pain/symptoms	None	- Of 498 pharmacist interventions, 103 (20%) cases were suggested treatment for ADR - Of 498 pharmacist interventions, the oncologist in the study approved 82 prescription suggestions made by the pharmacist by which 57% (n=47) of adverse drug reactions seen in patients was improved after prescriptions suggested by the pharmacist evaluation of the effect of pharmacist intervention on the management of adverse drug reactions for outpatients	Level 2 AHRQ- ADRs being considered as a surrogate to QoL unless measuring QoL via validated tool

Joy AM et al. (2021) ⁵³					receiving chemotherapy	
	- Prospective, randomized (Chit method) - Single centre - N = 130 ambulatory cancer patients - Intervention group: 65 patients - Control group: 65 patients 68 (52.3%) were females and 62 (47.7%) were males - Setting: Outpatient oncology department of a tertiary care hospital - Location: Mangaluru, India - Study duration: 6 months	- Inclusion criteria: 18 years of age or older - Diagnosed with any type of cancer. - On at least one oral agent on discharge (assuming antineoplastic agent) - Exclusion criteria: - Patients with mental illness - Patients with speaking difficulties	Intervention: - information leaflets and face to face medication counselling from clinical pharmacists at the beginning of the 6th month study - Assessment was done, using a validated 8-item Morisky medication adherence scale, at baseline and final follow up: - First 7 items dichotomised as “Yes” (score = 1) or “No” (score = 0) - Last item scores frequency of patient having difficulty remembering to take medications, as Never (score = 4), Once in a while (score = 3), Sometimes	Proactive vs reactive care	- Mean values in intervention and usual care group were compared using independent t-test. - Descriptive statistics (mean $\pm$ SD) were used to summarize the data. - Chi square test and Fishers exact test were used for additional data analysis. - Statistical significance was set at P < 0.05. - Mean $\pm$ SD for medication adherence at baseline: - Intervention group: 6.461 $\pm$ 1.36 - Usual care group: 6.65 $\pm$ 1.69 - Mean $\pm$ SD for medication adherence at follow up:	Level 2 AHRQ - surrogate outcomes (i.e., HR/BP)

Myers et al. (2023) ⁵⁴			(score = 2), Usually (score = 1), All the time (score = 0) - Sum of all answers calculated: - Score less than 6 = low adherence - Score 6 – 7 = moderated adherence - Score 8 = high adherence Control: - information leaflets and face to face medication counselling from clinical pharmacists at the end of the 6th month study		- Intervention group: 7.715 ± 0.509 - Usual care group: 6.67 ± 0.901	
	- The first part of the study employed a retrospective chart review to track pharmacist interventions in the study cohort (11 a priori intervention types) - The second part of the study used a retrospective matched cohort design, where the study cohort was matched 1:1 with the control cohort	Inclusion criteria: Ambulatory oncology patients receiving ICI-based therapies (atezolizumab, cemiplimab, durvalumab, ipilimumab, nivolumab, pembrolizumab)	Intervention: - Intensive oncology pharmacist-based education/intervention offered collaboratively within an interdisciplinary team. - Included: ICI and immune related adverse events (irAE) education prior to treatment initiation with a focus on	Proactive vs. reactive care	- In total, 1664 pharmacist interventions were performed across the 11 categories. - Supportive care recommendations were common. - Pharmacists facilitated significant interventions through referral for escalating symptoms, systemic immunotherapy	- Level 1 AHRQ (ER visits, hospitalizations) - Level 2 AHRQ (toxicity, prescription discontinuation)

	who received immune checkpoint inhibitors (ICI) treatment during the same time period. • N=143 • Median age 70 years old, whereby 60% being male (n=85) • January 2016-August 31, 2019 • Wilcoxon signed-rank tests was used to compare patient outcomes in relation to Emergency Department (ED) visits, hospitalizations due to adverse events and ICI cycles received between cancer center sites • McNemar test used to compare patient outcomes related to treatment discontinuation due to adverse events and completion of PD-1 (programmed death 1) and PD-L1 (programmed death 1 ligand) inhibitor courses between two sites.	- Exclusion criteria: - all patients undergoing/including in ICI-based clinical trials - Patients in the study cohort without documented pharmacist intervention(s) in Meditech - Patients who only received their ICI(s) as an inpatient - Patients that started (ICIs) as an inpatient without documented intervention(s) from outpatient oncology pharmacists after hospital discharge	identification of irAE 'red flag' symptoms and summary of ICI resources • Plus, proactive phone follow-up prior to first 3 cycles • Collaborative irAE management with oncologist/nursing staff Control: • No proactive pharmacist intervention		recommendations and medication adjustments. • 92 patients from each of the cancer centres were included in the matched cohort. • A higher odds of treatment discontinuation due to irAE(s) was identified in patients who did not receive dedicated pharmacist follow-up in the control cohort compared to the study cohort. (exact McNemar test, $p=0.022$, odds ratio (OR)=5.5 (95% CI: 1.2-24.8)) • There was no difference in the proportion of finite PD-1, or PD-L1 inhibitor treatment courses completed between the two sites (exact McNemar test, $p=0.388$)	
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Dürr et al. (2021) ⁵⁵	- Prospective, 1:1 randomized trial (randomization individualized by drug) - Multi-centre - N = 202 ambulatory cancer patients - Intervention group: 98 patients - Control group: 104 patients - Setting: Outpatient oncology department of 11 ambulatory clinics - Location: Germany - Study duration: 12 weeks	Inclusion criteria: 18 years of age or older - Diagnosed with any type of cancer. - On at least one newly prescribed oral agent - At least 16-week life expectancy Exclusion criteria: - Patients not meeting the inclusion criteria above.	Intervention arm: - Intensified pharmaceutical care program added to standard care (medication reconciliation, patient interview/assessment, providing and reviewing standardized written patient info material) - Patients were given structured patient counseling sessions in weeks 0, 1, 4, and 12 according to the recommended standards for orally administered antineoplastic agents published by the American Society of Clinical Oncology (ASCO). - The structured patient counseling sessions focused on the following four topics: (1) medication management, (2) counseling and training, (3) side effect prevention and management,	Proactive vs reactive care	- Number of drug related problems assessed by negative binomial regression model (co-primary endpoint) and patient satisfaction assessed via validated by Treatment Satisfaction Questionnaire for Medication (TSQM ((Ver II)) questionnaire and analyzed via longitudinal mixed-effect regression model (co-primary endpoint) - Secondary endpoints included number of side effects; number of severe side effects rate of side effects; combined end point of severe side effects (Common Terminology Criteria for Adverse Events (CTCAE) ≥ 3), treatment discontinuation, unscheduled hospitalization, and death; number of drug-related problems with reference to the	- Level 1 AHRQ- patient outcomes of morbidity - Level 2 AHRQ – treatment discontinuation and rates of severe toxicities
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			and (4) adherence counseling Control arm: • contact with clinical pharmacist at weeks 0, 4, and 12. Standard medical care as per disease specific routine practices at the institutions. Interventions or recommendations related to DRPs were done in control group if patient at risk of serious harm ("ethical reasons").		complete medication; patient treatment perception with their oral anticancer therapy; patient knowledge about their medication; health-related quality of life; and patient adherence; analyzed via logistic regression and Cox-proportional hazard models • Co-primary endpoint #1: Oncologic DRPs per patient were reduced in intervention arm vs control arm (3.85 vs 5.81, $p > 0.001$) over the 12-week period. • Co-primary endpoint #2: Patient satisfaction scores via validated questionnaire were higher in the intervention arm vs control (91.6 vs 74.4, $p < 0.001$) • The hazard ratio for the combined secondary endpoint of severe side effects (Common Terminology	
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					Criteria for Adverse Events ≥ 3), treatment discontinuation, unscheduled hospital admission, and death was 0.48 (95% CI, 0.32 to 0.71, $P < .001$) in favor of the intervention group	
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ADR - Adverse Drug Reactions; AHRQ - Agency for Healthcare Research and Quality; ALL - Acute Lymphoid Leukemia; AOcpKPI - Ambulatory Oncology Clinical Key Performance Indicator; ARR - Absolute Risk Reduction; ASCO - American Society of Clinical Oncology; BP - Blood Pressure; BPI - Brief Pain Inventory; CG - Control Group; CI - Confidence Interval; CINV - Chemotherapy-Induced Nausea and Vomiting; CSI - Clinically Significant Interactions; CTCAE - Common Terminology of Criteria for Adverse Events; DRPs - Drug Related Problems; ED – Emergency Department; EKG – Electrocardiogram; ESAS - Edmonton Symptom Assessment Scale; HR - Heart Rate; ICI - immune checkpoint inhibitors; IQR - Interquartile Range; irAE- immune related adverse events; IV – Intravenous; MM - Multiple Myeloma; MRPs - Medication Related Problems; MUSE - Medication Understanding and Use Self-Efficacy; NCCH - North Carolina Cancer Hospital; NCI – National Cancer Institute; NHL - Non-Hodgkin Lymphoma; OR – Odds Ratio; PD1 – programmed death-1; PD-L1 – programmed death-1 ligand; PFS- Progression Free Survival; PG - Pharmacist Intervention Group; QoL - Quality of Life; RDI - Relative Dose Intensities; SD - Standard Deviation; TSQM – Treatment Satisfaction Questionnaire for Medication

Step 4b: Preparation of evidence summary tables

The steering group evaluated 37 research papers from the literature search (see Table 2 above) and 18 that were added by the steering group. The 10 members (9 pharmacists and the author) were randomly assigned sets of studies to review based on criteria set by the research team, including population, pharmacist intervention/exposure, comparator, and outcome, as well as assigning an AHRQ outcome level. The articles were scored out of a possible total of 15 points. 5 points were available from the applicability of the included study population, 5 points available from the AHRQ level and 5 points (1 point each) awarded for each component of the AOcpKPI definition met. 22 articles scored between 13 and 15 in the process. Those 22 articles were reviewed in full text, and of those, 14 articles were selected to inform the critical activity topics. The review process for the evidence summary tables was assigned to Tom McFarlane and Lauren Hutton to ensure accuracy and confirm the inclusion or exclusion of the 14 articles in the evidence summary tables.

An example of the evidence summary tables is shown in Table 3 below. The 14 studies included 8 randomized controlled trials and 6 nonrandomized controlled before-and-after studies. The studies were classified according to AHRQ levels as follows: 2 studies in Level 1 (clinical and quality of life outcomes) and 9 in Level 2 (surrogate outcomes). Additionally, two studies were classified in both Levels 1 and 2, while one study was classified in both

Levels 2 and 3 (measurable variables with an indirect or unestablished connection to a target outcome). Specific details on the articles can be found in the evidence summary tables in Appendix A and highlighted in grey in Table 2 above. These findings confirmed that there was no need to expand the search to other practice settings for potential critical activity topics or candidate AOcpKPIs.

Step 5: Establishment of evidence-informed critical activity topics

Critical activity topics, defined as interventions directly connected to patient outcomes, were extracted from the 14 studies in the evidence summary tables. The most prevalent pharmacist interventions identified were chosen as critical activity topics to inform the AOcpKPIs used in the modified Delphi process. The steering group came to consensus on the following 9 critical activity topics for this project:

1. Pharmacist-led clinical medication order assessment
2. Pharmacist patient medication education
3. Pharmaceutical care plan (oncology)
4. Pharmaceutical care plan (non-oncology)
5. Medication history assessment by pharmacist
6. Interprofessional communication
7. Medication adherence assessment and management
8. Pharmacist conducted follow-up
9. Bundled patient care interventions

Table 3: Illustrative Example of Evidence Summary Tables

1. Article: Maleki, S., Glewis, S., Fua, T., Liu, C., Rischin, D., Alexander, M., Na, L. Lingaratnam, S. A randomised controlled trial of clinical pharmacy intervention versus standard care to improve medication adherence in outpatients with head and neck cancer receiving radiotherapy. <i>Support Care Cancer</i> 30 , 4243–4253 (2022). ³²		Prepared by: Lauren Hutton and Mike Leblanc (secondary review by Tom McFarlane)
A. Study objective	B. Intervention	C. Main results
Extrapolated practice question: - What is the impact of an outpatient clinical pharmacy service on medication adherence and symptom burden in cancer patients. Study objective: “Evaluate the impact of an outpatient clinical pharmacy service on medication adherence and symptom burden in cancer patients.”	Intervention: - Pharmacist was integrated part of radiotherapy outpatient team. Pharmacist delivered the multidisciplinary designed, evidence-informed pharmacist-led Pharmaceutical Care Program (PCP) - PCP was delivered over at least 4 sessions with clinic pharmacist (at least 2 more than standard of care which includes 2 sessions). Additional sessions beyond 4 were based on identified individual patient requirements. - PCP included: 1) Conduct and document accurate and comprehensive BPMH. 2) A) Identification and resolution of medication-related risk factors AND B) Monitoring of treatment related toxicities (with	181 patients eligible, 144 randomized, 12/71 in intervention arm did not complete second assessment (refused interview) vs 17/73 in control arm (13 refused interview, 4 unwell/unable to interview) - Intervention arm – n = 59 completed study - Control arm – n = 56 completed study Primary endpoint: medication adherence (MUSE and Teach-Back assessment) – change from baseline to follow up [AHRQ level 3] - MUSE (Medication Understanding and Use Self-Efficacy) scale [higher score = better outcome] – mean MUSE score difference at radiotherapy discharge was 2.7 favouring the intervention (Stat Sig difference). MUSE score decreased in control arm from baseline to discharge (29 to 27) and was maintained/increased in the intervention arm (30 to 31). Min / Max MUSE score at follow up in control arm was 8 / 32 vs intervention arm 22 / 32 (less variance seen in intervention arm vs control). - Teach-back assessment [higher score = better outcome] – control arm teach back assessment was unchanged from baseline to discharge (3.1 to 3.0). intervention arm teach back score increased

		recommendations for changes made to radiation oncologist to improve symptom control and optimize route of administration – <i>pharmaceutical care plan</i>) 3) Pharmacist patient (patient or caregiver) education 4) Development of individualized medication adherence aids (adapted to patient health literacy level) Control: - Standard of care provided: 2 assessment interviews by pharmacist (baseline – weeks 1 to 2) and at discharge from radiotherapy service (weeks 5 to 6). - Able to access pharmacy services – limited to individual patient referrals to outpatient dispensary or medicines information service.	from baseline to discharge (3.4 to 4.3). Teach-back score of ≥ 4 decreased in control group from baseline to charge (18% to 14%) vs increased in intervention arm (25% to 86%). (Stat Sig difference). Secondary endpoint: symptom burden [AHRQ level 2] Although NOT Stat Sig difference, the ESAS (Edmonton Symptom Assessment Scale) score was « better » (lower if better and higher if better) across all symptom categories for the intervention arm. Greatest impact seen in areas of general well being, tiredness, drowsiness, and « overall ».
D. Design	E. Patient population	F. Targeted outcomes and endpoints	G. Authors' conclusions
- Prospective - Parallel RCT (1:1) - Non-pharmacy clinical staff	Inclusion: - Patients 18 years or older - Newly starting radiotherapy +/- concurrent chemotherapy	Primary outcome: medication adherence as assessed by Medication Understanding and Use Self-Efficacy (MUSE) scale and Teach-Back assessment.	“The outpatient clinic pharmacist working within a multidisciplinary radiotherapy clinic produced a clinically meaningful improvement in patient understanding of medicines information and patient adherence to medication instructions, and

(oncologist, nursing, allied health) blinded to the intervention. • Single centre – cancer centre for adults • Clinic pharmacist administered study assessments and delivery of interventions. • N = 115 patients • Location: 1 hospital, Australia • Duration and follow up not included.	• Radiotherapy dose of at least 40 Gy Exclusion: • Barriers for communication evident • Already enrolled in another clinical trial Baseline characteristics: • Table 1 includes all important criteria. • Overall, more metropolitan (66%) patients vs regional (34%). • Most patients had stage 1 to 3 disease (56%) • 2 patients (4%) in control arm received concurrent chemotherapy vs none in intervention arm. • Control and intervention groups are similar, with the following exceptions: more medication use in the intervention arm (12 [20%] vs 5 [9%]), more HPV + patients in intervention arm (26 [44%] vs 17 [30%])	Secondary exploratory outcome: patient-reported symptom burden assessed by the Edmonton. Symptom Assessment Scale (ESAS) Statistical analysis: • Used per-protocol-analysis – patients who did not complete the second evaluation (at discharge from radiotherapy) were not included. • Powered (using 2-sided, type 1 error rate of 5%) to detect a three-point difference in MUSE score and 30% difference between proportion of patients with ≥ 4 between arms in Teach-Back assessment at discharge. • Conducted linear regression to assess for univariate factors associated with each outcome. Primary outcome: • Medication adherence was assessed according to two indices: the Medication Understanding and Use Self-Efficacy (MUSE) scale to measure patients' behaviours towards medication adherence, and objective patient Teach-Back assessment scores collected by the pharmacist verifying patient understanding of medicines information and use.	reduction in the overall cancer disease and treatment-related symptom burden.”
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		Secondary outcomes: • Patient reported outcomes relating to symptom burden were also assessed using the Edmonton Symptom Assessment System (ESAS). Statistical analysis: • All analyses included patients who completed assessments at both baseline and discharges. • Powered (2-sided type 1 error rate of 5%) to detect at discharge, a three-point difference in MUSE score and 30% difference between arms in the proportion of patients with Teach-Back score of four or more. • Linear regression models adjusted for their score at baseline were used to compare allocation arms in MUSE and ESAS scores at discharge.	
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Strengths	APPLICATION/SYNTHESIS: How does this study inform the AOcpKPI selection process (methods, AOcpKPI selection criteria, and candidate AOcpKPI)?
• RCT linked to meaningful AHRQ level 3 and 2 patient outcomes. • Small sample size (n = 115) • Unit of randomization was patient, and not ward or team. • Clinically appropriate follow up duration (length of treatment) • Intervention was comprehensive and adaptable, reflective of real-world practice. • Intervention was described in enough detail to replicate, and time commitment was logged. • Intervention was practical and authentic to the services pharmacist's desire to provide. • Bundled intervention reflective of real-world practice. • Randomized, controlled trial. • Used MUSE for adherence assessment and patient reported symptom burden was assessed using ESAS. ○ All established tools to assess the desired outcome. • Used Teach-Back (well known teaching technique) to assess comprehension. First study to do so. • Same pharmacist did all the assessments. • Randomization was effective in achieving comparable groups.	• One of only a few RCTs looking at impact of true pharmaceutical care on AO outpatients. • Intervention was a bundle of critical elements and represented comprehensive pharmacists' services provided to patients from radiotherapy initiation to completion/discharge. • Highlights the impact of pharmacists as part of the health care team, and their influence on patient outcomes. • Pharmacist-led pharmaceutical care may improve medication adherence and patient self-efficacy. The medications studied were not systemic anticancer therapy (in all but 2 patients); largely supportive medications or for management of comorbidities). There was no description of radiotherapy dose intensity was reported. • Patients received the critical elements as a bundle, which included pharmaceutical care and services such as medication reconciliation, drug review to identify and resolve DTPs, patient education, and monitoring. • The independent critical elements (i.e.. patient education) used in this study may serve as surrogate markers for reduced morbidity (health resource utilization) or quality of life (improved symptom burden). Mortality measures would require longer duration of follow up.

	• We must be cautious about extrapolating the results of this study to other treatment methodologies beyond radiotherapy. • Potential denominator metrics for AOcpKPI could include total number of patients newly starting on treatment. • RCT evaluating the impact of structured interventions including BPMH, toxicity assessment and education on patient adherence to medications as well as symptom burden. • Intervention was a bundle of possible activities that could be identified as KPIs. • Outcomes are meaningful and measurable in general practice so may be valuable to select other candidate KPIs. • Highlights the impact of pharmacists as part of the health care team, and their influence on patient outcomes.
Limitations	What are the patterns (similarities and differences) compared to other key papers?
• Generalizability ○ Only two patients on concurrent chemo-radiotherapy. May not be able to generalize to patients on systemic anticancer therapy. ○ Not multi-centre, study done in 1 hospital. ○ Australian health care system • Limitations with blinding: ○ The only “unblinded” participant – the clinic pharmacist – did the intervention and assessment which may have introduced assessor bias or patient social desirability bias. ○ Blinding of other practitioners not described and may have been difficult to achieve in reality as the pharmacist made all recommendations for pharmacotherapy optimization	Similarities: • Rate of medication adherence has been an outcome measured in many of the key papers including Quinn, Oliviera and Caracuel. ○ Maleki group used MUSE tool (a predictive tool of an intention to perform a given behaviour) to assess adherence rates. ○ There are no clear, consensus tool used to measure adherence rates.

to the treating radiation oncologist (i.e., if occurring at times other than baseline and discharge, would infer the patient is in intervention arm). • No description of radiotherapy treatment dose intensity the patient was able to receive secondary to receiving the pharmacist services (what is the link between radiotherapy dose intensity and treatment outcomes?). • Medication adherence measure of non-systemic anticancer therapy not as clearly linked to surrogate outcomes of improved morbidity/mortality/QoL (AHRQ level 1). • Need for validated tool to assess patient comprehension. • Not powered to show statistical difference for healthcare system utilization. • Although randomized, the groups did differ in the number of participants who had a “carer” supporting them. This may have explained the differences in adherence and will need to be confirmed in future studies.	Similar somewhat to the Myers paper that directly compared a standard of care with reactive/minimal pharmacy services to a more comprehensive and proactive clinical pharmacy program (bundled intervention). Differences: • Only study evaluating role of pharmacist in patients receiving radiotherapy exclusively. • One of only a few RCTs included looking at this research topic. • Limited generalizability to patients on systemic anticancer therapy
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Step 6: Establishment of candidate AOcpKPIs for the Delphi Process

The steering group generated a list of candidate AOcpKPIs based on the evidence-informed critical activity topics. This list identified metrics from the critical activity topics that aligned with the 5-point AOcpKPI definition.

The 15 proposed candidate AOcpKPIs for the modified Delphi process were:

- AOcpKPI #1 - Proportion of patients who receive oncology pharmacist clinical order review (cancer associated medication orders were clinically reviewed by an oncology pharmacist)
- AOcpKPI #2 - Proportion of patients who receive education about their cancer-associated medications by an oncology pharmacist
- AOcpKPI #3 - Proportion of patients for whom an oncology pharmacist has developed and initiated a pharmaceutical care plan related to a patient's cancer or cancer-associated medications (inclusive of drug therapy problem resolution)
- AOcpKPI #4 - Proportion of patients for whom an oncology pharmacist recommends or initiates a dose adjustment (including a medication hold) of a patient's cancer-associated medications
- AOcpKPI #5 - Proportion of patients who have received an oncology pharmacist drug interaction assessment (inclusive of interaction management initiation)
- AOcpKPI #6 - Proportion of patients who had one or more drug therapy problems identified and resolved by an oncology pharmacist
- AOcpKPI #7 - Number(s) and type(s) of drug therapy problems identified and resolved by an oncology pharmacist

- AOcpKPI #8- Proportion of patients who receive monitoring for and management of cancer-associated medication adverse drug reactions or toxicities by an oncology pharmacist
- AOcpKPI #9- Proportion of patients for whom an oncology pharmacist recommended or coordinated additional examinations/treatments related to a patient's cancer or cancer associated medication
- AOcpKPI #10 - Proportion of patients for whom an oncology pharmacist has developed and initiated a pharmaceutical care plan related to a patient's non-cancer comorbidity
- AOcpKPI #11 - Proportion of patients for whom an oncology pharmacist conducts or reviews an ambulatory medication reconciliation (inclusive of initiation of drug therapy problem management)
- AOcpKPI #12 - Proportion of patients for whom the oncology pharmacist initiated interprofessional communication to prevent or resolve a drug therapy problem
- AOcpKPI #13 - Proportion of patients for whom an oncology pharmacist educates about or monitors for cancer-associated medication adherence (inclusive of management of identified issues)
- AOcpKPI #14 - Proportion of patients who receive pharmaceutical care from an oncology pharmacist after an initial oncology pharmacy encounter (i.e., follow up)
- AOcpKPI #15 - Proportion of patients who receive a comprehensive direct patient care BUNDLE from an oncology pharmacist working in collaboration with the interprofessional health care team (NOTE: BUNDLE = explicit care elements of AOcpKPIs #2, #6, #8, #12, and #14; explicit care elements to be discussed at live

meeting that are represented as a bundle in trials and may likely include other candidate AOcpKPI care element provided concurrently)

Step 7: Delphi Survey Tool Creation

Surveys were developed using Qualtrics (Qualtrics, 2023)¹⁴ for each of the three rounds, starting with a consent request before panelists ranked the candidate AOcpKPIs. Each survey included a brief description of the study's purpose, an explanation of the Delphi process, details about participation, ranking questions for the candidate AOcpKPIs and a comment box for feedback. An example of the Delphi survey used in round 1 is shown in Figure 4 below.

Round 1 included demographic questions and a comment box for feedback on existing AOcpKPIs and suggestions for additional ones. Round 2 featured a similar box for new suggestions, while Round 3 provided a box for final remarks and a question to rank the critical activity topics.

The Delphi panelists received instructions on how to rank each candidate AOcpKPI including its description and the ranking system. Panelists first rated their agreement with the 9 selection criteria and then provided a final rating on the statement: “OVERALL RATING: Measuring this clinical pharmacy key performance indicator (cpKPI) is useful in advancing clinical pharmacy practice to improve the quality of patient care.” This final prompt reiterated the primary objective of the survey: to evaluate the importance of the AOcpKPI in improving the quality of care through clinical pharmacy practice. By emphasizing that measuring the AOcpKPI is crucial for advancing clinical pharmacy, the prompt encouraged panelists to consider both its technical aspects and its real-world impact on patient outcomes.

This specific wording was chosen to provide clear, unambiguous instructions, ensuring all panelists interpret the question consistently and reliably. This clarity prevents confusion or varied interpretations that could compromise the evaluation process, making it subjective and unreliable. By focusing panelists on the key criteria, the precision of the wording strengthens the integrity of the final selection of AOcpKPIs.

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Please rate the proposed clinical pharmacy Key Performance Indicator using the 9 consensus selection criteria below. Consensus on whether this candidate Key Performance Indicator should be included in the final list of indicators will be determined based only on the panelists' overall rating of that cpKPI. However, please use your ratings of the other 9 selection criteria to assist you in the final overall rating.

Candidate cpKPI #1: Proportion of patients who receive oncology pharmacist clinical order review (cancer associated medication orders were clinically reviewed by an oncology pharmacist)

Candidate cpKPI Description: Oncology pharmacist conducting clinical order review for cancer associated medication protocols (including review of relevant test/exam results)

	Strongly disagree (1)	(2)	Disagree (3)	(4)	Neither agree or disagree (5)	(6)	Agree (7)	(8)	Strongly agree (9)
I. Based on high quality evidence	☐	☐	☐	☐	☐	☐	☐	☐	☐
II. Relevant impact on clinically important outcomes	☐	☐	☐	☐	☐	☐	☐	☐	☐
III. Sensitive/specific to ambulatory oncology pharmacist's contribution / scope of practise	☐	☐	☐	☐	☐	☐	☐	☐	☐
IV. Attributable to direct patient reactive and proactive care delivery settings	☐	☐	☐	☐	☐	☐	☐	☐	☐
V. Aligned with professional goals, objectives, practices	☐	☐	☐	☐	☐	☐	☐	☐	☐
VI. Feasible to measure	☐	☐	☐	☐	☐	☐	☐	☐	☐
VII. Efficient to measure	☐	☐	☐	☐	☐	☐	☐	☐	☐
VIII. Valuable quality measure	☐	☐	☐	☐	☐	☐	☐	☐	☐
IX. Generalizability	☐	☐	☐	☐	☐	☐	☐	☐	☐
OVERALL RATING: Measuring this clinical pharmacy key performance indicator (cpKPI) is useful in advancing oncology pharmacy practice to improve the quality of patient care.	☐	☐	☐	☐	☐	☐	☐	☐	☐

Figure 4: Delphi Survey Instrument Example Designed using Qualtrics¹⁴

Step 8a: Delphi panel selection, recruitment, and consent process

Delphi Panel Selection Criteria

The Delphi panel comprised 18 pharmacists including key opinion leaders, new practitioners, and experienced oncology pharmacists. The following selection criteria were established by the steering group:

1. Geographic representation (province and region)
2. Urban vs. rural community size
3. Academic vs. community hospital setting
4. Representation across sex
5. Official Canadian language representation
6. Level of experience – new vs. experienced practitioners
7. Front line clinicians vs. leadership vs. pharmacy practice researchers
8. Type of oncology practice focus (hematologic vs. solid malignancies vs. specific tumour site)
9. Adult vs. pediatric patient population
10. Type of oncology practice setting, divided into proactive and reactive care based on definitions set out in a previous study done by Makowsky et al. (2009)⁵⁶. Please refer to reference for proactive vs reactive definitions.

Delphi Panel Size

According to de Villiers et al. (2005), the optimal size for a Delphi panel typically ranged from 15 to 30 participants.⁵⁷ This study included 18 panelists, which facilitated effective discussion and data collection without complicating analysis. According to a review article,

larger panels (over 30 participants) were found to be challenging to manage and often resulted in lower response rates, while smaller panels lacked credibility and failed to achieve a representative consensus.⁵⁷

Delphi Recruitment Process

Panelist selection, guided by criteria above from the steering group, ensured a diverse group that met all outlined criteria for inclusivity. Recruitment involved sending email invitations to selected individuals explaining the research focus, Delphi process, and time commitment and inviting their participation. Potential panelists were proposed by individual members of the steering group and collectively approved by the group before invitations were distributed.

Delphi Consent Process

Panelists received a consent letter detailing the study's purpose and anonymity assurance. Interested panelists accessed the surveys via a link, consenting by selecting "yes" to a consent statement before starting. The study received ethics clearance (ORE #44328) from the University of Waterloo Research Ethics Board. As part of the ethical review process, the study design ensured that participation was voluntary and that participants retained the right to withdraw at any time.

Step 8b: Education Training Package

Before the Delphi process began, the research team created and distributed to panelists an orientation recording to explain the modified Delphi process, evidence summary tables, and relevant primary literature journal articles for reference. This package equipped the panelists with the necessary background information to understand their expectations in the study and to make informed decisions when ranking each candidate AOcpKPI during the three survey rounds.

CHAPTER 3: Modified Delphi Methodology (Steps 9-10)

Step 9: Three-round Delphi Process

A 3-round Delphi process achieved consensus on candidate AOcpKPIs, which is recognized as the gold standard approach.^{58,59} This project used a modified Delphi method, incorporating a live meeting via Zoom for panelists to discuss candidate AOcpKPIs before final rankings were provided in round 3. Survey links were emailed to panelists, who had approximately three weeks to complete them, with reminder emails sent one week before the deadline to boost response rates. Panelists who opted out of the study were removed between rounds.

Each round involved a panel of ambulatory oncology experts assessing how well candidate AOcpKPIs met the nine predefined selection criteria. Panelists ranked candidates using a 9-point Likert scale, submitting responses on the platform (Qualtrics). The 9-point Likert scale had a range from 1 = strongly disagree, 3 = disagree, 5 = neither agree nor disagree, 7 = agree, and 9 = strongly agree. In rounds 1 and 2, all candidate AOcpKPIs advanced to the next round, regardless of ratings. In round 3, only those candidate cpKPIs rated 7 or higher were considered as reaching consensus for inclusion.

In rounds 2 and 3, panelists received average individual and group rankings and comments from the previous round to ensure panelists were fully informed of the results prior to the next round of voting, and they could also propose new candidate AOcpKPIs at the end of rounds 1 and 2. In round 3, after considering group feedback and discussions, panelists finalized their rankings, ordering the consensus AOcpKPI critical activity topics by potential to improve patient care quality. The modified Delphi rounds occurred in this sequence: round 1, round 2,

live meeting, and round 3.

Data Analysis within each round:

Data analysis was performed using templates provided by the authors of the Fernandes et al. (2015) study.¹³ For each Delphi round, panelists' comments and feedback, along with average overall rankings from all submissions, were compiled. To effectively present this data, a comprehensive dashboard was created, which included the group mean overall rating, group median overall rating, and group composite mean. This dashboard, along with verbatim panelist comments, was sent to panelists for each subsequent round. Furthermore, a graphical analysis was created for each AOcpKPI using data from the dashboard and a summary of verbatim panelist comments, helping the research team visualize and understand the scores.

Live Meeting:

The live meeting was held via Zoom after Round 2, organized by the research team. Its purpose was to discuss issues and controversies related to the marginal (yellow) candidate AOcpKPIs. The yellow candidate AOcpKPIs were evaluated alongside more well-defined ones, enabling collaborative input on their relevance and applicability within ambulatory oncology pharmacy. This meeting provided an opportunity for panelists to suggest modifications to wording or to propose new candidate AOcpKPIs. The live meeting discussion facilitated informed voting and ensured panelists' questions were answered and discussed prior to Round 3. Panelists were encouraged to record draft scores for each candidate AOcpKPI to aid their evaluations ahead of the final ranking in round 3.

Step 10: Consensus and Final Review of Candidate AOcpKPIs

At the end of round three, the panel submitted their final overall ratings for each AOcpKPI based on the nine selection criteria and overall ranking question. A consensus was achieved for candidate AOcpKPIs when at least 75% of the panelists ranked them between 7 and 9 on the 9-point Likert scale. The research team then reviewed the finalized list of consensus AOcpKPIs for accuracy.

Post-Delphi Phase

At the end of round 3 of the modified Delphi, the selected consensus AOcpKPIs were reviewed by the research team and aligned with the previously mentioned thematic critical activity areas.

CHAPTER 4: RESULTS

Delphi Panel Demographics

Eighteen individuals consented to participate from seven provinces across Canada: Alberta, British Columbia, Manitoba, New Brunswick, Newfoundland, Nova Scotia, and Ontario. During round 2, two panelists withdrew, reducing the active participants to 16; 14/16 (87.5%) attended the live meeting, while the remaining two watched a recording.

Seventeen out of eighteen panelists worked with adult patients, while one specialized in pediatrics. Their practice areas included clinical leadership/administration, clinical, education, drug distribution and front line. Most had over 20 years of experience, representing 61.1% (11/18) of the group, and all 18 reported English as their primary language.

The gender distribution was seven males and eleven females which is reflective of a balanced gender distribution seen in the clinical practice setting. The panelists came from various practice settings, such as teaching hospitals, community hospitals, and academia. Their educational backgrounds included Bachelor of Science in Pharmacy (BScPhm), Master's degrees, Doctor of Pharmacy (PharmD), and Accredited Canadian Pharmacy Residency (ACPR), or a combination of these qualifications.

The focus of their oncology practice varied: 11/18 worked with heme tumors, 15/18 with solid tumors, and 1/18 with specific tumor sites. Detailed demographic characteristics are provided in Table 4 below.

Table 4: Demographic Breakdown of Delphi Panelists (N=18)

Demographic Characteristic	N (%) of Respondents
<u>Province</u>	
Alberta	2 (11%)
British Columbia	3 (17%)
Manitoba	1 (6%)
New Brunswick	2 (11%)
Newfoundland	1 (6%)
Nova Scotia	2 (11%)
Ontario	7 (39%)
<u>Practice Area*</u>	
Clinical Leadership/Administration	9 (50%)
Clinical	10 (56%)
Education	3 (17%)
Drug Distribution	6 (33%)
Front Line	4 (22%)
<u>Practice Setting</u>	
Teaching Hospital	8 (44%)
Community Hospital	6 (33%)
Academia	1 (6%)
	3 (17%)

Other: teaching hospital and community specialty practice, ambulatory heme-oncology, oncology specialty pharmacy	
<u>Patient Population</u>	
Adults	17 (94%)
Pediatrics	1 (6%)
<u>Years of Experience</u>	
0-5	2 (11%)
6-10	2 (11%)
11-15	2 (11%)
16-20	1 (6%)
20+	11 (61%)
<u>Educational Background*</u>	
Bachelor of Science in Pharmacy (BScPhm)	14 (78%)
Master's Degree (MSc)	7 (39%)
Doctor of Pharmacy (PharmD)	10 (56%)
Accredited Canadian Pharmacy Residency (ACPR)	9 (50%)
Other: Master of Science (MSc) Oncology, Board Certified Oncology Pharmacist (BCOP), Bachelor of Science (BSc), BSc Nursing, Post-doctoral fellowship, Master of Business Administration (MBA)	6 (33%)
<u>Sex</u>	

Male	7 (39%)
Female	11 (61%)
<u>Oncology Practice Focus*</u>	
Heme Tumour	11 (61%)
Solid Tumour	15 (83%)
Specific Tumour Site	1 (6%)
Other: Clinical leadership supporting all	1 (6%)
<u>Primary Language used in Practice</u>	
English	18 (100%)
French	0
Other	0
<u>Role at Practice Site*</u>	
Front line care/patient education	10 (56%)
Drug compounding and distribution	7 (39%)
Administrator	5 (28%)
Clinical practice lead	10 (56%)
Clinical researcher	4 (22%)
Other: Drug program administration	2 (11%)

***Sum exceeds 18 as more than one response could be selected per participant**

Round 1 Delphi Results

In round 1 of the Delphi study, 15 candidate AOcpKPIs were evaluated. The research team set the threshold for consensus as 'green' AOcpKPIs for scores of 7 or greater on the 9-point Likert scale by at least 75% of the panelists. 'Yellow' AOcpKPIs, with scores between 6-7, and 'red' AOcpKPIs, with scores below 6, were classified to aid panelists in visualizing the ratings. This classification process was also applied in the next round.

In summary, the 9 green AOcpKPIs included numbers 1, 2, 3, 5, 6, 8, 13, 14, and 15; the 3 yellow AOcpKPIs were numbers 4, 7, and 11; and the 3 red AOcpKPIs were numbers 9, 10, and 12. There were no new suggestions for AOcpKPIs during round 1. Additional results from this round are provided as follows:

- Table 5 provides details on the number of panelists who scored each candidate cpKPI along with the overall mean score
- Figure 5 is an example rating distribution for candidate AOcpKPI #1
- Table 6 shows an example of the dashboard of results provided to panelists for the next round
- Table 7 summarizes recurring comment themes for each candidate AOcpKPI
- Appendix B provides verbatim comments received

Table 5: Round 1 Delphi Results

Met Threshold (Green)	Almost Met Threshold (Yellow)	Not met Threshold (Red)
AOcpKPI #1: Proportion of patients who receive oncology pharmacist clinical order review (cancer-associated medication orders were clinically reviewed by an oncology pharmacist) ➤ 16/18 (88.9%) panelists scored 7 or greater on 9-point Likert scale ➤ Overall Mean score = 7.72	AOcpKPI #4: Proportion of patients for whom an oncology pharmacist recommends or initiates a dose adjustment (including a medication hold) of a patient's cancer-associated medications) ➤ 13/18 (72.2%) panelists scored 7 or greater on 9-point Likert scale ➤ Overall Mean score = 7.28	AOcpKPI #9: Proportion of patients for whom an oncology pharmacist referred for or coordinated additional examinations/treatments related to a patient's cancer or cancer-associated medication ➤ 8/18 (44.4%) panelists scored 7 or greater on 9-point Likert scale ➤ Overall Mean score = 6.17
AOcpKPI #2: Proportion of patients who receive education about their cancer-associated medications by an oncology Pharmacist	AOcpKPI #7: Number(s) and type(s) of drug therapy problems identified and resolved by an oncology pharmacist	AOcpKPI #10: Proportion of patients for whom an oncology pharmacist has developed and initiated a pharmaceutical care

➤ 17/18 (94.4%) panelists scored 7 or greater on 9-point Likert scale ➤ Overall Mean score = 8	➤ 10/18 (55.6%) panelists scored 7 or greater on 9-point Likert scale ➤ Overall Mean score = 6.94	plan related to a patient's non-cancer comorbidity ➤ 7/18 (38.9%) panelists scored 7 or greater on 9-point Likert scale ➤ Overall Mean score = 5.47
AOcpKPI #3: Proportion of patients for whom an oncology pharmacist has developed and initiated a pharmaceutical care plan related to a patient's cancer or cancer-associated medications (inclusive of drug) ➤ 16/18 (88.9%) panelists scored 7 or greater on 9-point Likert scale ➤ Overall Mean score = 7.83	AOcpKPI #11: Proportion of patients for whom an oncology pharmacist conducts or reviews an ambulatory medication reconciliation (inclusive of initiation of drug therapy problem management) ➤ 13/18 (72.2%) panelists scored 7 or greater on 9-point Likert scale ➤ Overall Mean score = 7.06	AOcpKPI #12: Proportion of patients for whom the oncology pharmacist initiated interprofessional communication to prevent or resolve a drug therapy problem ➤ 9/18 (50%) panelists scored 7 or greater on 9-point Likert scale ➤ Overall Mean score = 6.67
AOcpKPI #5: Proportion of patients who have received an		

oncology pharmacist drug interaction assessment (inclusive of interaction management initiation) ➤ 15/18 (83.3%) panelists scored 7 or greater on 9-point Likert scale ➤ Overall Mean score = 7.83		
AOcpKPI #6: Proportion of patients who had one or more drug therapy problems identified and resolved by an oncology pharmacist ➤ 16/18 (88.9%) panelists scored 7 or greater on 9-point Likert scale ➤ Overall Mean score = 7.94		
AOcpKPI #8: Proportion of patients who receive monitoring for and management of cancer-associated medication adverse		

drug reactions or toxicities by an oncology pharmacist ➤ 15/18 (83.3%) panelists scored 7 or greater on 9-point Likert scale ➤ Overall Mean score = 7.61		
AOcpKPI #13: Proportion of patients for whom an oncology pharmacist educates about or monitors for cancer-associated medication adherence (inclusive of management of identified issues) ➤ 16/18 (88.9%) panelists scored 7 or greater on 9-point Likert scale ➤ Overall Mean score = 7.89		
AOcpKPI #14: Proportion of patients who receive pharmaceutical care from an oncology pharmacist after an		

initial oncology pharmacy encounter (follow up) ➤ 16/18 (88.9%) panelists scored 7 or greater on 9-point Likert scale ➤ Overall Mean score = 7.44		
AOcpKPI #15: Proportion of patients who receive a comprehensive direct patient care BUNDLE from an oncology pharmacist working in collaboration with the interprofessional health care team ➤ 15/18 (83.3%) panelists scored 7 or greater on 9-point Likert scale ➤ Overall Mean score = 7.33		

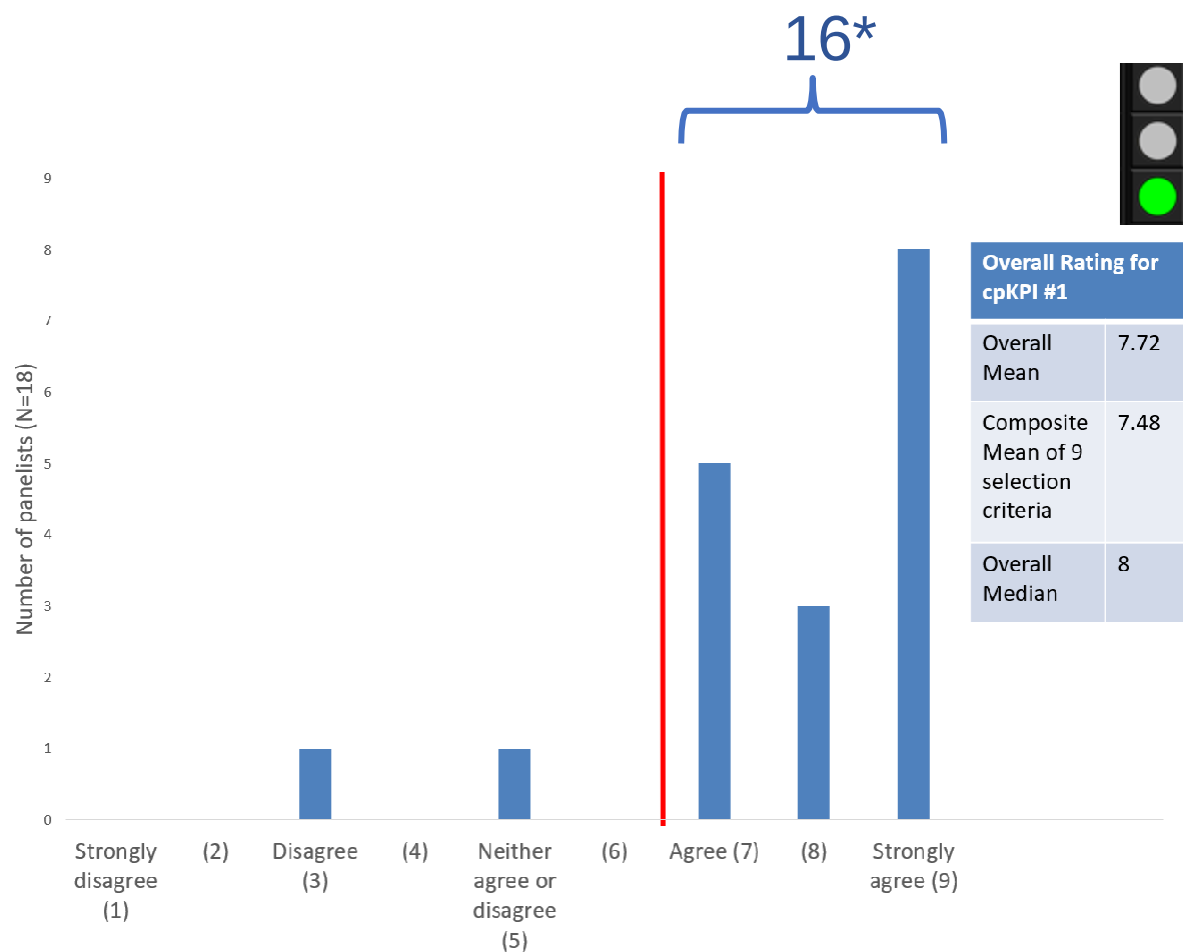


Figure 5: Round 1 Analysis of AOcpKPI#1: Graphical Data Visualization- Proportion of patients who receive oncology pharmacist clinical order review (cancer associated medication orders were clinically reviewed by an oncology pharmacist) (N=18)). Red bar represents the point at which threshold is met (score of 7 or greater on 9-point Likert scale)

* Sum of panelist votes

Table 6: Example of Round 1 Panelist Dashboard

#	AOcpKPI	My overall rating	Group mean overall rating	Group median overall rating	Group composite mean	Overall rating frequency distribution range
1	Proportion of patients who receive oncology pharmacist clinical order review (cancer-associated medication orders were clinically reviewed by an oncology pharmacist)	9	7.72	8	7.48	3-9
2	Proportion of patients who receive education about their cancer-associated medications by an oncology pharmacist	7	8	8	7.70	6-9
3	Proportion of patients for whom an oncology pharmacist has developed and initiated a pharmaceutical care plan related to a patient's cancer or cancer-associated medications (inclusive of drug therapy problem resolution)	7	7.83	8	7.62	4-9
4	Proportion of patients for whom an oncology pharmacist recommends or initiates a dose adjustment (including a medication hold) of a patient's cancer-associated medications	6	7.28	7	7.52	5-9
5	Proportion of patients who have received an oncology pharmacist drug interaction assessment (inclusive of interaction management initiation)	8	7.83	8	7.80	5-9
6	Proportion of patients who had one or more drug therapy problems identified and resolved by an oncology pharmacist	8	7.94	8	7.88	6-9
7	Number(s) and type(s) of drug therapy problems identified and resolved by an oncology pharmacist	7	6.94	7	7.42	5-9
8	Proportion of patients who receive monitoring for and management of cancer-associated medication adverse drug reactions or toxicities by an oncology pharmacist	8	7.61	8	7.56	3-9

9	Proportion of patients for whom an oncology pharmacist referred for or coordinated additional examinations/treatments related to a patient's cancer or cancer-associated medication	7	6.17	6	6.46	3-8
10	Proportion of patients for whom an oncology pharmacist has developed and initiated a pharmaceutical care plan related to a patient's non-cancer comorbidity	6	5.47	6	6.18	2-8
11	Proportion of patients for whom an oncology pharmacist conducts or reviews an ambulatory medication reconciliation (inclusive of initiation of drug therapy problem management)	8	7.0	7	7.23	4-9
12	Proportion of patients for whom the oncology pharmacist initiated interprofessional communication to prevent or resolve a drug therapy problem	7	6.67	6.5	6.85	4-9
13	Proportion of patients for whom an oncology pharmacist educates about or monitors for cancer-associated medication adherence (inclusive of management of identified issues)	8	7.89	8	7.76	6-9
14	Proportion of patients who receive pharmaceutical care from an oncology pharmacist after an initial oncology pharmacy encounter (follow up)	7	7.44	8	7.33	3-9
15	Proportion of patients who receive a comprehensive direct patient care BUNDLE from an oncology pharmacist working in collaboration with the interprofessional health care team (NOTE: BUNDLE = explicit care elements of education (KPI 2), DTP (KPI 6), monitors and manages toxicity (KPI 8), interprofessional communication (KPI 12), follow up (KPI 14); explicit care elements to be discussed at live meeting that are represented as a bundle in trials and may likely include other candidate AOcpKPI care element provided concurrently)	7	7.33	8	7.31	4-9

Table 7: Prevalent Delphi Comments from Round 1

#	AOcpKPI	Prevalent Comment Themes
1	Proportion of patients who receive oncology pharmacist clinical order review (cancer-associated medication orders were clinically reviewed by an oncology pharmacist)	- Definition of oncology pharmacist - Wording and how this AOcpKPI will be measured
2	Proportion of patients who receive education about their cancer-associated medications by an oncology pharmacist	- Definition of oncology pharmacist - Provision of patient education - Overlap with #12 - Specificity
3	Proportion of patients for whom an oncology pharmacist has developed and initiated a pharmaceutical care plan related to a patient's cancer or cancer-associated medications (inclusive of drug therapy problem resolution)	- Feasibility/difficulty of measurement
4	Proportion of patients for whom an oncology pharmacist recommends or initiates a dose adjustment (including a medication hold) of a patient's cancer-associated medications	- Feasibility/difficulty of measurement
5	Proportion of patients who have received an oncology pharmacist drug interaction assessment (inclusive of interaction management initiation)	- Feasibility/difficulty of measurement - Distinguish between role of oncology pharmacist vs. regular pharmacist
6	Proportion of patients who had one or more drug therapy problems identified and resolved by an oncology pharmacist	- Same as #7 - Overlap with #3 - Feasibility/difficulty of measurement
7	Number(s) and type(s) of drug therapy problems identified and resolved by an oncology pharmacist	- Too similar to #6 - Changes in wording is needed - Feasibility
8	Proportion of patients who receive monitoring for, and management of cancer-associated medication adverse drug reactions or toxicities by an oncology pharmacist	- Collaborative environment needed - Overlap with #7 - Dependent on practice setting

9	Proportion of patients for whom an oncology pharmacist referred for or coordinated additional examinations/treatments related to a patient's cancer or cancer-associated medication	- Outside of pharmacist scope
10	Proportion of patients for whom an oncology pharmacist has developed and initiated a pharmaceutical care plan related to a patient's non-cancer comorbidity	- More training of pharmacists is needed - Not specific enough/out of scope to oncology pharmacist role
11	Proportion of patients for whom an oncology pharmacist conducts or reviews an ambulatory medication reconciliation (inclusive of initiation of drug therapy problem management)	- Out of scope for oncology pharmacist - Change in wording needed
12	Proportion of patients for whom the oncology pharmacist initiated interprofessional communication to prevent or resolve a drug therapy problem	- Terminology confusing, needs clarification on definition of interprofessional communication - Out of scope of oncology pharmacist
13	Proportion of patients for whom an oncology pharmacist educates about or monitors for cancer-associated medication adherence (inclusive of management of identified issues)	- Difficulty in measuring adherence - Overlap with #12
14	Proportion of patients who receive pharmaceutical care from an oncology pharmacist after an initial oncology pharmacy encounter (follow up)	- Too general
15	Proportion of patients who receive a comprehensive direct patient care BUNDLE from an oncology pharmacist working in collaboration with the interprofessional health care team (NOTE: BUNDLE = explicit care elements of education (KPI 2), DTP (KPI 6), monitors and manages toxicity (KPI 8), interprofessional communication (KPI 12), follow up (KPI 14); explicit care elements to be discussed at live meeting that are represented as a bundle in trials and may likely include other candidate AOcpKPI care element provided concurrently)	- Feasibility/difficulty of measurement - Too general / not specific enough

Round 2 Delphi Results

Of the 15 candidate AOcpKPIs, 12/15 (80%) were rated between 7 and 9 on the 9-point Likert scale (classified as 'green'). These included AOcpKPIs #1, 2, 3, 5, 6, 8, 13, and 15.

Candidate AOcpKPIs #4, 7, 11, 12, and 14 fell into the yellow category, while AOcpKPIs #9 and 10 were classified as red. No new candidate AOcpKPIs were suggested during round 2. Results for round 2 are presented in Table 8, with recurring comment themes summarized in Table 9.

Detailed verbatim comments can be found in Appendix C.

Table 8: Round 2 Delphi Results

Met Threshold (Green)	Almost Met Threshold (Yellow)	Not Met Threshold (Red)
AOcpKPI #1: Proportion of patients who receive oncology pharmacist clinical order review (cancer-associated medication orders were clinically reviewed by an oncology pharmacist) ➤ 15/16 (93.8%) panelists scored 7 or greater on 9-point Likert scale ➤ Overall Mean score = 7.75	AOcpKPI #4: Proportion of patients for whom an oncology pharmacist recommends or initiates a dose adjustment (including a medication hold) of a patient's cancer-associated medications) ➤ 12/16 (75%) panelists scored 7 or greater on 9-point Likert scale ➤ Overall Mean score = 7.38	AOcpKPI #9: Proportion of patients for whom an oncology pharmacist referred for or coordinated additional examinations/treatments related to a patient's cancer or cancer-associated medication ➤ 7/16 (43.8%) panelists scored 7 or greater on 9-point Likert scale ➤ Overall Mean score = 6.19
AOcpKPI #2: Proportion of patients who receive education about their cancer-associated medications by an oncology pharmacist	AOcpKPI #7: Number(s) and type(s) of drug therapy problems identified and resolved by an oncology pharmacist	AOcpKPI #10: Proportion of patients for whom an oncology pharmacist has developed and initiated a pharmaceutical care

➤ 15/16 (93.8%) panelists scored 7 or greater on 9-point Likert scale ➤ Overall Mean score = 7.88	➤ 12/16 (75%) panelists scored 7 or greater on 9-point Likert scale ➤ Overall Mean score = 6.88	plan related to a patient's non-cancer comorbidity ➤ 3/16 (18.8%) panelists scored 7 or greater on 9-point Likert scale ➤ Overall Mean score = 5.60
AOcpKPI #3: Proportion of patients for whom an oncology pharmacist has developed and initiated a pharmaceutical care plan related to a patient's cancer or cancer-associated medications (inclusive of drug) ➤ 14/16 (87.5%) panelists scored 7 or greater on 9-point Likert scale ➤ Overall Mean score = 7.63	AOcpKPI #11: Proportion of patients for whom an oncology pharmacist conducts or reviews an ambulatory medication reconciliation (inclusive of initiation of drug therapy problem management) ➤ 12/16 (75%) panelists scored 7 or greater on 9-point Likert scale ➤ Overall Mean score = 6.88	
AOcpKPI #5: Proportion of patients who have received an oncology pharmacist drug interaction assessment (inclusive	AOcpKPI #12: Proportion of patients for whom the oncology pharmacist initiated interprofessional communication to prevent or resolve a drug therapy problem	

of interaction management initiation) ➤ 15/16 (93.8%) panelists scored 7 or greater on 9-point Likert scale ➤ Overall Mean score = 7.81	➤ 9/16 (56.3%) panelists scored 7 or greater on 9-point Likert scale ➤ Overall Mean score = 6.31	
AOcpKPI #6: Proportion of patients who had one or more drug therapy problems identified and resolved by an oncology pharmacist ➤ 14/16 (87.5%) panelists scored 7 or greater on 9-point Likert scale ➤ Overall Mean score = 7.73	AOcpKPI #14: Proportion of patients who receive pharmaceutical care from an oncology pharmacist after an initial oncology pharmacy encounter (follow up) ➤ 12/16 (75%) panelists scored 7 or greater on 9-point Likert scale ➤ Overall Mean score = 6.87	
AOcpKPI #8: Proportion of patients who receive monitoring for and management of cancer-associated medication adverse drug reactions or toxicities by an oncology pharmacist		

➤ 15/16 (93.8%) panelists scored 7 or greater on 9-point Likert scale ➤ Overall Mean score = 7.75		
AOcpKPI #13: Proportion of patients for whom an oncology pharmacist educates about or monitors for cancer-associated medication adherence (inclusive of management of identified issues) ➤ 15/16 (93.8%) panelists scored 7 or greater on 9-point Likert scale ➤ Overall Mean score = 7.88		
AOcpKPI#15: Proportion of patients who receive a comprehensive direct patient care BUNDLE from an oncology pharmacist working in collaboration with the		

interprofessional health care team ➤ 14/16 (87.5%) panelists scored 7 or greater on 9-point Likert scale ➤ Overall Mean score = 7.50		
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Table 9: Prevalent Delphi Comments from Round 2

#	AOcpKPI	Prevalent Comments
1	Proportion of patients who receive oncology pharmacist clinical order review (cancer-associated medication orders were clinically reviewed by an oncology pharmacist)	- Scope of oncology pharmacist
2	Proportion of patients who receive education about their cancer-associated medications by an oncology pharmacist	- Too general
3	Proportion of patients for whom an oncology pharmacist has developed and initiated a pharmaceutical care plan related to a patient's cancer or cancer-associated medications (inclusive of drug therapy problem resolution)	- Definition of pharmaceutical care plan is needed
4	Proportion of patients for whom an oncology pharmacist recommends or initiates a dose adjustment (including a medication hold) of a patient's cancer-associated medications	- Scope of practice Feasibility
5	Proportion of patients who have received an oncology pharmacist drug interaction assessment (inclusive of interaction management initiation)	- Should be linked with #11
6	Proportion of patients who had one or more drug therapy problems identified and resolved by an oncology pharmacist	- Is the same as #7
7	Number(s) and type(s) of drug therapy problems identified and resolved by an oncology pharmacist	- See comment above for #6
8	Proportion of patients who receive monitoring for, and management of cancer-associated medication adverse drug reactions or toxicities by an oncology pharmacist	- Challenges with generalizability
9	Proportion of patients for whom an oncology pharmacist referred for or coordinated additional examinations/treatments related to a patient's cancer or cancer-associated medication	- Clarification needed - Difficult to measure - Relevance

10	Proportion of patients for whom an oncology pharmacist has developed and initiated a pharmaceutical care plan related to a patient's non-cancer comorbidity	- Wording - Generalizability an issue
11	Proportion of patients for whom an oncology pharmacist conducts or reviews an ambulatory medication reconciliation (inclusive of initiation of drug therapy problem management)	- Inclusion of both medication reconciliation and best possible medication history (BPMH) recommended
12	Proportion of patients for whom the oncology pharmacist initiated interprofessional communication to prevent or resolve a drug therapy problem	- Unclear wording - Should be part of #6 and #7 - Difficult to measure - Out of scope
13	Proportion of patients for whom an oncology pharmacist educates about or monitors for cancer-associated medication adherence (inclusive of management of identified issues)	- Practice-specific and resource-dependent
14	Proportion of patients who receive pharmaceutical care from an oncology pharmacist after an initial oncology pharmacy encounter (follow up)	- Too similar to #3
15	Proportion of patients who receive a comprehensive direct patient care BUNDLE from an oncology pharmacist working in collaboration with the interprofessional health care team (NOTE: BUNDLE = explicit care elements of education (KPI 2), DTP (KPI 6), monitors and manages toxicity (KPI 8), interprofessional communication (KPI 12), follow up (KPI 14); explicit care elements to be discussed at live meeting that are represented as a bundle in trials and may likely include other candidate AOcpKPI care element provided concurrently)	- Difficult to measure - Bundle consistent with literature evidence

Live Meeting

The live meeting, led by the research team, took place via Zoom on Saturday, January 13, 2024. Of the 16 panelists, 14 attended, while 2 were unable to join but later viewed the recording. The meeting began with introductions, followed by an overview of the results from rounds 1 and 2, a recap of the Delphi process, data analysis, major themes from panelist comments, and evidence from the literature review. Panelists were also engaged to explore why certain yellow and red candidate AOcpKPIs did not meet the threshold.

The focus of the meeting was to review issues/controversies regarding candidate AOcpKPIs close to meeting the threshold (yellow), with red AOcpKPIs reviewed afterward. Additionally, any ambiguities that panelists had about the Delphi process were addressed during the meeting. The discussions covered the wording and definitions of the yellow and red indicators, leading to agreed modifications. For example, the wording of yellow candidate AOcpKPIs #4, #11, and #14 in round 2 was revised based on panelist feedback, while no changes were made to #7 and #12, as detailed in Table 10. Specifically, candidate AOcpKPI #4 was adjusted to clarify the distinction between therapy modification and dose adjustment. The final wording was revised to: “Proportion of patients for whom an oncology pharmacist recommends or initiates therapy modification (e.g., dose adjustment, medication hold, or medication change) of a patient’s cancer-associated medications”. For AOcpKPI #11, changes were made to reduce confusion about medication reconciliation, history, and BPMH. AOcpKPI #16 was created to better reflect these distinctions: 1) the proportion of patients for whom an

oncology pharmacist conducts a comprehensive medication review. Additionally, AOcpKPI #14 was revised for clarity regarding follow-up and the scope of pharmaceutical care. The final wording was revised to “Proportion of patients who receive pharmaceutical care follow-up from an oncology pharmacist after an initial oncology pharmacy encounter”.

Changes were made to the red candidate AOcpKPI #10 to reword "developed and initiated a pharmaceutical care plan" to "addressed pharmaceutical care" AOcpKPI #17 was added that included cancer and non-cancer care needs of the patient. The final wording was revised to: “% of oncology patients for whom an oncology pharmacist has developed and initiated a pharmaceutical care plan (inclusive of the patient’s cancer and non-cancer comorbidities)”. No changes were made to #9.

After discussion over the yellow and red candidate AOcpKPIs, there was limited time to address the green AOcpKPIs, which had already reached broad consensus. Following panelist feedback from rounds 1 and 2, a list of definitions (see Table 11) was provided to help clarify any misunderstandings.

Table 10: Chart Summary of Changes in Delphi Candidate AOcpKPIs Post-Live Meeting

AOcpKPI#	Pre-Live Meeting Wording	Post-Live Meeting Wording	Round 2 Ranking Category
1	Proportion of patients who receive oncology pharmacist clinical order review (cancer-associated medication orders were clinically reviewed by an oncology pharmacist)	No change	Green
2	Proportion of patients who receive education about their cancer-associated medications by an oncology pharmacist	No change	Green
3	Proportion of patients for whom an oncology pharmacist has developed and initiated a pharmaceutical care plan related to a patient's cancer or cancer-associated medications (inclusive of drug therapy problem resolution)	No change	Green
4	Proportion of patients for whom an oncology pharmacist recommends or initiates a dose adjustment (including a medication hold) of a patient's cancer-associated medications	Proportion of patients for whom an oncology pharmacist recommends or initiates therapy modification (e.g., dose adjustment, medication hold, or medication change) of a patient's cancer-associated medications	Yellow
5	Proportion of patients who have received an oncology pharmacist drug interaction assessment (inclusive of interaction management initiation)	No change	Green
6	Proportion of patients who had one or more drug therapy problems identified and resolved by an oncology pharmacist	No change	Green

7	Number(s) and type(s) of drug therapy problems identified and resolved by an oncology pharmacist	No change	Yellow
8	Proportion of patients who receive monitoring for and management of cancer-associated medication adverse drug reactions or toxicities by an oncology pharmacist	No change	Green
9	Proportion of patients for whom an oncology pharmacist recommended or coordinated additional examinations/treatments related to a patient's cancer or cancer-associated medication	No change	Red
10	Proportion of patients for whom an oncology pharmacist has developed and initiated a pharmaceutical care plan related to a patient's non- cancer comorbidity.	Proportion of patients for whom an oncology pharmacist has addressed pharmaceutical care related to a patient's non-cancer comorbidity.	Red
11	Proportion of patients for whom an oncology pharmacist conducts or reviews an ambulatory medication reconciliation (inclusive of initiation of drug therapy problem management)	Proportion of patients for whom an oncology pharmacist reviews a comprehensive BPMH (may include conducting, reconciliation, inclusive of initiation of drug therapy problem management)	Yellow
12	Proportion of patients for whom the oncology pharmacist initiated interprofessional communication to prevent or resolve a drug therapy problem	No change	Yellow
13	Proportion of patients for whom an oncology pharmacist educates	No change	Green

	about or monitors for cancer-associated medication adherence (inclusive of management of identified issues)		
14	Proportion of patients who receive pharmaceutical care from an oncology pharmacist after an initial oncology pharmacy encounter (follow up)	Proportion of patients who receive pharmaceutical care follow-up from an oncology pharmacist after an initial oncology pharmacy encounter.	Yellow
15	Proportion of patients who receive a comprehensive direct patient care BUNDLE from an oncology pharmacist working in collaboration with the interprofessional health care team (NOTE: BUNDLE = explicit care elements of education (KPI 2), DTP (KPI 6), monitors and manages toxicity (KPI 8), interprofessional communication (KPI 12), follow up (KPI 14); explicit care elements to be discussed at live meeting that are represented as a bundle in trials and may likely include other candidate AOcpKPI care element provided concurrently)	No change	Green
16		Proportion of patients for whom an oncology pharmacist conducts a comprehensive medication review (may include reconciliation, inclusive of initiation of drug therapy problem management)	New candidate AOcpKPI
17		Proportion of oncology patients for whom an oncology pharmacist has developed and initiated a pharmaceutical care plan (inclusive of a patient's	New candidate AOcpKPI

	cancer and non-cancer comorbidities)
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Bolded text means the term is associated with a formal definition that is provided and referenced in the companion definition document.

Table 11: Clarified Key Definitions for Panelists in Delphi Process

Terminology	Definition and Reference
Medication review	A structured evaluation of a patient's medications with the aim of optimizing medication use and improving health outcomes and may encompass detecting drug-related problems and recommending interventions. (World Health Organization 2019) ⁶⁰
Pharmaceutical care (PC)	Involves a practitioner assuming responsibility for a patient's drug-related needs. It involves the completion of all steps in the patient care process, specifically (1) assessment of the patient (i.e., medical problems and drug therapies, which can lead to identification of drug therapy problems), (2) development of a care plan, and (3) follow-up evaluations. Pharmaceutical care involves identifying, resolving and preventing drug-therapy problems. (Cipolle et al. 2012) ⁶¹
Drug therapy problems (DTP)	Undesirable events or risks experienced by the patient that involve or are suspected to involve drug therapy that inhibit or delay the patient from achieving the desired goals of therapy, and that require professional judgment to resolve. Drug therapy problems are identified by evaluating whether the patient's drug therapy is appropriate, effective, and safe and whether the patient is adherent with his or her medications. (Cipolle et al. 2012) ⁶¹
Best possible medication history (BPMH)	A history created using (1) a systematic process for interviewing the patient/family; and (2) a review of at least one other reliable source of information (i.e., jurisdictional medication databases, inspection of medication vials, or contacting the community pharmacy) to obtain and verify prescription and non- prescription medications. (ISMP Canada 2017b) ⁶⁰
Pharmaceutical care plan	A treatment plan that is founded on pharmaceutical care and which is developed according to the following standards of care. (Cipolle et al. 2012) ⁶¹
Medication management	An overarching concept that describes the delivery of patient-centered care to optimize safe, effective, and appropriate drug therapy that includes care that is provided through collaboration with patients and their healthcare teams. (ISMP Canada 2017b) ⁶⁰

Round 3 Delphi Results and Final Consensus AOcpKPIs

Round 3 of the Delphi study included a total of 17 candidate AOcpKPIs. Of these, 14/17 (82.4%) were classified as green, having received ratings between 7 and 9 on the 9-point Likert scale. The green candidate AOcpKPIs were #1, 2, 3, 4, 5, 6, 7, 8, 11, 13, 14, 15, 16, and 17. The remaining 3 AOcpKPIs, #9, 10, and 12, were classified as red. Details of the candidate AOcpKPI results for round 3 are provided in Table 12. The recurring comment themes from panelists for each candidate AOcpKPI in round 3 are summarized in Table 13. For detailed verbatim comments from round 3, please see Appendix D.

The final consensus AOcpKPIs, listed in Table 14, represent 8 of the 9 critical activity topics, which include: clinical medication order review, patient education, pharmaceutical care plan (oncology), pharmaceutical care plan (non-oncology), adherence assessment and management, follow-up, bundled patient care interventions, and medication history assessment. One critical activity area, interprofessional communication, was not represented. Panelists also ranked the 9 critical activity topics corresponding to the final 14 consensus ambulatory oncology AOcpKPIs in round 3, as shown in Table 15. The purpose of this is to highlight the urgency of these critical activity topics, enabling pharmacists to prioritize their tasks based on importance, especially when time constraints prevent them from addressing all areas.

Table 12: Round 3 Delphi Results

Met Threshold (Green)	Not Met Threshold (Red)
AOcpKPI #1: Proportion of patients who receive oncology pharmacist clinical order review (cancer-associated medication orders were clinically reviewed by an oncology pharmacist) ➤ 15/16 (93.8%) panelists scored 7 or greater on 9-point Likert scale ➤ Overall Mean score = 8.06	AOcpKPI #9: Proportion of patients for whom an oncology pharmacist recommended or coordinated additional examinations/treatments related to a patient's cancer or cancer-associated medication ➤ 4/16 (25%) panelists scored 7 or greater on 9-point Likert scale ➤ Overall Mean score = 5.4
AOcpKPI #2: Proportion of patients who receive education about their cancer-associated medications by an oncology pharmacist ➤ 16/16 (100%) panelists scored 7 or greater on 9-point Likert scale ➤ Overall Mean score = 8.31	AOcpKPI #10: Proportion of patients for whom an oncology pharmacist has addressed pharmaceutical care related to a patient's non-cancer comorbidity ➤ 5/16 (31.3%) panelists scored 7 or greater on 9-point Likert scale ➤ Overall Mean score = 5.81

AOcpKPI #3: Proportion of patients for whom an oncology pharmacist has developed and initiated a pharmaceutical care plan related to a patient's cancer or cancer-associated medications (inclusive of drug therapy problem resolution) ➤ 15/16 (93.8%) panelists scored 7 or greater on 9-point Likert scale ➤ Overall Mean score = 7.56	AOcpKPI#12: Proportion of patients for whom the oncology pharmacist initiated interprofessional communication to prevent or resolve a drug therapy problem ➤ 6/16 (37.5%) panelists scored 7 or greater on 9-point Likert scale ➤ Overall Mean score = 5.63
AOcpKPI #4: Proportion of patients for whom an oncology pharmacist recommends or initiates therapy modification (e.g., dose adjustment, medication hold or medication change) of a patient's cancer-associated medications ➤ 16/16 (100%) panelists scored 7 or greater on 9-point Likert scale ➤ Overall Mean score = 8.19	
AOcpKPI #5: Proportion of patients who have received an oncology pharmacist drug	

interaction assessment (inclusive of interaction management initiation) ➤ 14/16 (87.5%) panelists scored 7 or greater on 9-point Likert scale ➤ Overall Mean score = 8.13	
AOcpKPI #6: Proportion of patients who had one or more drug therapy problems identified and resolved by an oncology pharmacist ➤ 13/16 (81.3%) panelists scored 7 or greater on 9-point Likert scale ➤ Overall Mean score = 7.56	
AOcpKPI #7: Number(s) and type(s) of drug therapy problems identified and resolved by an oncology pharmacist ➤ 12/16 (75%) panelists scored 7 or greater on 9-point Likert scale ➤ Overall Mean score = 6.94	
AOcpKPI #8: Proportion of patients who receive monitoring for and management of cancer-associated medication adverse drug	

reactions or toxicities by an oncology pharmacist ➤ 15/16 (93.8%) panelists scored 7 or greater on 9-point Likert scale ➤ Overall Mean score = 8	
AOcpKPI #11: Proportion of patients for whom an oncology pharmacist reviews a comprehensive BPMH (may include conducting, reconciliation, inclusive of initiation of drug therapy problem management) ➤ 12/16 (75%) panelists scored 7 or greater on 9-point Likert scale ➤ Overall Mean score = 7.25	
AOcpKPI #13: Proportion of patients for whom an oncology pharmacist educates about or monitors for cancer-associated medication adherence (inclusive of management of identified issues) ➤ 16/16 (100%) panelists scored 7 or greater on 9-point Likert scale ➤ Overall Mean score = 7.81	

AOcpKPI#14: Proportion of patients who receive pharmaceutical care follow-up from an oncology pharmacist after an initial oncology pharmacy encounter ➤ 14/16 (87.5%) panelists scored 7 or greater on 9-point Likert scale ➤ Overall Mean score = 7.63	
AOcpKPI#15: Proportion of patients who receive a comprehensive direct patient care BUNDLE from an oncology pharmacist working in collaboration with the interprofessional health care team (NOTE: BUNDLE = explicit care elements of education (KPI 2), DTP (KPI 6), monitors and manages toxicity (KPI 8), interprofessional communication (KPI 12), follow up (KPI 14); explicit care elements to be discussed at live meeting that are represented as a bundle in trials and may likely include other candidate AOcpKPI care element provided concurrently) ➤ 15/16 (93.8%) panelists scored 7 or greater on 9-point Likert scale	

➤ Overall Mean score = 7.63	
AOcpKPI#16: Proportion of patients for whom an oncology pharmacist conducts a comprehensive medication review (may include reconciliation, inclusive of initiation of drug therapy problem management) ➤ 12/16 (75%) panelists scored 7 or greater on 9-point Likert scale ➤ Overall Mean score = 7.44	
AOcpKPI#17: Proportion of oncology patients for whom an oncology pharmacist has developed and initiated a pharmaceutical care plan (inclusive of a patient's cancer and non-cancer comorbidities) ➤ 12/16 (75%) panelists scored 7 or greater on 9-point Likert scale ➤ Overall Mean score = 6.69	

Table 13: Prevalent Delphi Comments from Round 3

#	AOcpKPI	Prevalent Themes
1	Proportion of patients who receive oncology pharmacist clinical order review (cancer-associated medication orders were clinically reviewed by an oncology pharmacist)	- None
2	Proportion of patients who receive education about their cancer-associated medications by an oncology pharmacist	- Change wording
3	Proportion of patients for whom an oncology pharmacist has developed and initiated a pharmaceutical care plan related to a patient's cancer or cancer-associated medications (inclusive of drug therapy problem resolution)	- Overlap with #14 and 17
4	Proportion of patients for whom an oncology pharmacist recommends or initiates therapy modification (e.g., dose adjustment, medication hold, or medication change) of a patient's cancer associated medications.	- Change wording
5	Proportion of patients who have received an oncology pharmacist drug interaction assessment (inclusive of interaction management initiation)	- None
6	Proportion of patients who had one or more drug therapy problems identified and resolved by an oncology pharmacist	- Overlap with #3, #4, and #7
7	Number(s) and type(s) of drug therapy problems identified and resolved by an oncology pharmacist	- Combine with #4 - Overlap with #6
8	Proportion of patients who receive monitoring for and management of cancer-associated medication adverse drug reactions or toxicities by an oncology pharmacist	- Overlap with #14 and #17 - Clarity needed in wording
9	Proportion of patients for whom an oncology pharmacist referred for or coordinated additional	- Overlap with #14 and #17

	examinations/treatments related to a patient's cancer or cancer-associated medication	
10	Proportion of patients for whom an oncology pharmacist has addressed pharmaceutical care related to a patient's non-cancer comorbidity.	- Change wording - Overlap with #17
11	Proportion of patients for whom an oncology pharmacist reviews a comprehensive BPMH (may include conducting, reconciliation, inclusive of initiation of drug therapy problem management)	- Change in wording
12	Proportion of patients for whom the oncology pharmacist initiated interprofessional communication to prevent or resolve a drug therapy problem	- Difficult to measure - In line with discussion at live meeting
13	Proportion of patients for whom an oncology pharmacist educates about or monitors for cancer-associated medication adherence (inclusive of management of identified issues)	- Dependent on who is monitoring adherence
14	Proportion of patients who receive pharmaceutical care follow-up from an oncology pharmacist after an initial oncology pharmacy encounter.	- Overlap with previous AOcpKPIs
15	Proportion of patients who receive a comprehensive direct patient care BUNDLE from an oncology pharmacist working in collaboration with the interprofessional health care team (NOTE: BUNDLE = explicit care elements of education (KPI 2), DTP (KPI 6), monitors and manages toxicity (KPI 8), interprofessional communication (KPI 12), follow up (KPI 14); explicit care elements to be discussed at live meeting that are represented as a bundle in trials and may likely include other candidate AOcpKPI care element provided concurrently)	- Need identification of AOcpKPIs included in bundle
16	Proportion of patients for whom an oncology pharmacist conducts a comprehensive medication review (may include reconciliation, inclusive of initiation of drug therapy problem management)	- Prefer wording of this AOcpKPI over #11

- 17 Proportion of oncology patients for whom an oncology pharmacist has developed and initiated a pharmaceutical care plan (inclusive of a patient's cancer and non-cancer comorbidities) - Prefer wording of this AOcpKPI over #3

Table 14: Consensus Clinical Pharmacy Key Performance Indicators (AOcpKPIs)

Candidate AOcpKPI	Thematic AOcpKPI Critical Activity Area(s)	Number (%) of Ratings of 7-9 (n= 16 panelists)
2. Proportion of patients who receive education about their cancer associated medications by an oncology pharmacist	• Patient education	16 (100%)
4. Proportion of patients for whom an oncology pharmacist recommends or initiates therapy modification (e.g., dose adjustment, medication hold or medication change) of a patient's cancer-associated medications	• Pharmaceutical care plan (oncology) • Clinical order review	16 (100%)
13. Proportion of patients for whom an oncology pharmacist educates about or monitors for cancer-associated medication adherence (inclusive of management of identified issues)	• Adherence assessment and management • Follow up	16 (100%)
1. Proportion of patients who receive oncology pharmacist clinical order review (cancer-associated medication orders were clinically reviewed by an oncology pharmacist)	• Clinical order review	15 (94%)
3. Proportion of patients for whom an oncology pharmacist has developed and initiated a pharmaceutical care plan related to a patient's cancer or cancer-associated	• Pharmaceutical care plan (oncology) • Medication history assessment • Clinical order review	15 (94%)

medications (inclusive of drug therapy problem resolution)	
8. Proportion of patients who receive monitoring for and management of cancer-associated medication adverse drug reactions or toxicities by an oncology pharmacist	- Pharmaceutical care plan (oncology) 15 (94%) - Follow up
15. Proportion of patients who receive a comprehensive direct patient care BUNDLE from an oncology pharmacist working in collaboration with the interprofessional health care team (NOTE: BUNDLE = explicit care elements of education (KPI 2), DTP (KPI 6), monitors and manages toxicity (KPI 8), interprofessional communication (KPI 12), follow up (KPI 14); explicit care elements to be discussed at live meeting that are represented as a bundle in trials and may likely include other candidate AOcpKPI care element provided concurrently)	Bundled patient care interventions 15 (94%)
5. Proportion of patients who have received an oncology pharmacist drug interaction assessment (inclusive of interaction management initiation)	- Pharmaceutical care plan (oncology) 14 (88%) - Clinical order review - Medication history assessment
14. Proportion of patients who receive pharmaceutical care follow-up from an oncology pharmacist after an	Follow up 14 (88%)

initial oncology pharmacy encounter		
6. Proportion of patients who had one or more drug therapy problems identified and resolved by an oncology pharmacist	• Pharmaceutical care plan (oncology) • Clinical order review - Medication history assessment	13 (81%)
7. Number(s) and type(s) of drug therapy problems identified and resolved by an oncology pharmacist	• Pharmaceutical care plan (oncology) • Clinical order review - Medication history assessment	12 (75%)
11. Proportion of patients for whom an oncology pharmacist reviews a comprehensive BPMH (may include conducting, reconciliation, inclusive of initiation of drug therapy problem management)	• Medication history assessment	12 (75%)
16. Proportion of patients for whom an oncology pharmacist conducts a comprehensive medication review (may include reconciliation, inclusive of initiation of drug therapy problem management)	• Pharmaceutical care plan (oncology) • Clinical order review - Medication history assessment	12 (75%)
17. Proportion of oncology patients for whom an oncology pharmacist has developed and initiated a pharmaceutical care plan (inclusive of a patient's cancer and non-cancer comorbidities)	• Pharmaceutical care plan (non-oncology) • Follow up	12 (75%)

The rank of each critical activity topic was determined by the total number of points it received (Table 15). This ranking reflects the order of importance assigned by the Delphi panelists, from greatest to least importance. The critical activity topic with the lowest points achieved the highest ranking and the critical activity topic with the highest number of points achieved the lowest ranking.

Table 15: Ranking of Pre-Delphi Consensus AOcpKPI Critical Activity Topics

Rank	Answer Options	Number of Points
1	Pharmacist led clinical medication order assessment	29
2	Pharmaceutical care plan (oncology)	56
3	Pharmacist patient medication education	58
3	Bundled patient care interventions	58
4	Medication adherence assessment and management	59
5	Pharmacist conducted follow-up	71
6	Medication history assessment by pharmacist	74
7	Pharmaceutical care plan (non-oncology)	102
8	Interprofessional communication	109

An example of the calculation used to determine the points for each critical activity topic is provided below in Table 16.

Table 16: Data Calculation Example for Critical Activity Topic: Pharmacist-Led Clinical Medication Order Review

Rank Number	Total Number of Votes by Delphi Panelist	Total points: (rank) x (votes)
1	6	An example of the cell information for row 1 would be “6”
2	5	
3	0	
4	2	
5	1	
6	0	
7	0	
8	0	
9	0	
Total points = (6x1) + (5x2) + (0x3) + (2x4) + (1x5) = 29 points		

CHAPTER 5: DISCUSSION

This research project focused on the design of AOcpKPIs as a strategic initiative aimed at advancing ambulatory oncology pharmacy practice to improve patient outcomes. The modified Delphi process was conducted over three rounds (with a live meeting before the final round) and aimed to reach a consensus on key metrics or AOcpKPIs. A panel of 18 ambulatory oncology pharmacists, selected by the steering group to represent the ambulatory oncology pharmacy sector in Canada, participated in this systematic consensus process. Beginning with 15 candidate AOcpKPIs in round 1, the process concluded with 14 selected AOcpKPIs covering 8 of the 9 critical activity areas in ambulatory oncology pharmacy practice. Panelists provided valuable feedback throughout, leading to important revisions in the definitions and wording of several AOcpKPIs. Strong consensus was seen in the final set of AOcpKPIs, supported by a predefined 5-point AOcpKPI definition and 9 clear AOcpKPI selection criteria (ideal attributes).

The selection of the final 14 AOcpKPIs reflected the panelists' careful consideration, although the rationale behind their scoring decisions across the three rounds of the modified Delphi process was not directly documented. The consistently high scores observed for certain AOcpKPIs may have been supported by the evidence summary tables provided to the panelists, which highlighted the best available data in ambulatory oncology pharmacy practice to ensure the panelists were informed as they participated in the voting process.

Strengths and Limitations

Literature search

Comprehensive medical databases (Embase and PubMed) and an inclusive search strategy were employed to ensure that the majority of relevant research in ambulatory oncology pharmacy was explored in this study. The resulting evidence summary tables helped the panelists assess prevalent critical activity topics in a concise and digestible format. However, this approach has some limitations. For instance, the summarization process included some studies that lacked comparator arms, placebo groups, or those conducted in a single center. Since the steering group filtered out weaker studies, panelists were encouraged to suggest additional candidate AOcpKPIs that might be missing from the current literature and search strategies to address potential gaps a method used to overcome the aforementioned limitation.

Modified Delphi process

The Delphi process is a systematic and iterative approach that involves multiple rounds of questioning and feedback, enabling experts to continuously reconsider and refine their opinions. This method emphasized feasibility, fostering rich discussions about the practicality of implementing and measuring each AOcpKPI. As the process can be time-consuming, a weakness seen in the methodology, panelists may also experience fatigue completing this process in addition to their regular workloads. This could have impacted the study results whereby fatigue could have influenced panelists to make quicker decisions, potentially leading to a consensus that was reached too hastily without careful consideration of all evidence or alternative viewpoints. The research team effectively managed this by allowing ample time for panelists to submit their responses, conducting the live meeting online for convenience, and

following up via email to ensure participants remained engaged. In this research study, the extended timeline was advantageous, allowing for thorough decision-making without the pressure to make quick decisions.

This methodology utilized a consensus-building approach, bringing together a diverse group of experts in ambulatory oncology who are well-versed in the latest advancements and current guidelines, to identify key metrics. The inclusion of new and experienced experts from varied educational backgrounds, practice settings, and geographical locations ensured that the selected AOcpKPIs reflected a broad consensus on the most significant pharmacist interventions.

The research team acknowledged that while this approach fosters broad consensus, it may not always result in the most effective AOcpKPIs. To mitigate this, the team took proactive steps to ensure a thorough evaluation process by providing comprehensive literature evidence and allowing panelists access to mean and median ratings of the Delphi panel to inform their scoring. The modified Delphi methodology aimed to minimize groupthink through anonymity and independent input; however, there is still the potential for conformity. Participants were also encouraged to provide honest feedback during live meetings to promote independent judgment, although this would not necessarily eliminate groupthink completely.

By summarizing and presenting Delphi data, particularly marginal AOcpKPIs, the research team sparked constructive conversations. They prepared targeted questions in advance, ensuring that key topics were addressed, which helped maintain focus during the meeting and promoted valuable exchanges of ideas between panelists and the research team. However, this focus on marginal AOcpKPIs may have inadvertently led to less discussion on other metrics. Despite these concerns, the broad consensus on green AOcpKPIs reached in Round 2 before the

live meeting suggests that any potential bias was minimal and did not significantly affect the study's overall findings.

Through meticulous planning by the research team, thoughtful selection of panelists, and effective facilitation, the team successfully addressed potential challenges within the modified Delphi design. These efforts significantly enhanced the quality of the finalized list of AOcpKPIs, reflecting a strong consensus.

Significance of AOcpKPIs

The research project's significance in ambulatory oncology pharmacy lies in the creation of AOcpKPIs that provide a standardized approach to measure and enhance the quality of pharmacy care for this patient population. This project addressed the need for consistent metrics to evaluate the impact of pharmacists' interventions, particularly as the roles of ambulatory oncology pharmacists expand. This is important because evidence of their contributions to patient outcomes is less established compared to oncology pharmacists practicing in acute care.

Consensus AOcpKPIs provide a framework for systematically documenting pharmacists' interventions, enabling the tracking of their contributions to patient care over time. This documentation increases accountability and emphasizes the value pharmacists bring to improving patient outcomes. By focusing on AOcpKPIs directly tied to outcomes, such as medication adherence management and patient education, pharmacists are encouraged to prioritize evidence-based interventions that enhance patient care quality.

Additionally, AOcpKPIs promote consistency in care across institutions, helping to reduce disparities caused by location or resource limitations. By generating concrete data, these

AOcpKPIs establish clear performance standards and highlight resource gaps. This evidence supports requests for additional staffing or funding by linking resources to measurable improvements in care quality. Furthermore, AOcpKPIs help quantify workload and impact, facilitating better workforce planning and resource allocation to sustain high-quality care.

Future Directions

Over time, tracking AOcpKPI data allows pharmacists to monitor trends in their interventions and contributions to patient care over time. While this documentation highlights areas of impact and accountability, additional analysis is needed to directly establish the efficacy of specific interventions. By focusing on AOcpKPIs linked to improved outcomes, pharmacists can use this data to support evidence-based practices and prioritize interventions with proven effectiveness. Continuous tracking of AOcpKPIs allows for ongoing assessment of staffing and resource utilization, providing feedback on performance and fostering an agile response to changing patient care demands. As oncology pharmacy practice process of care intervention literature progresses, the AOcpKPIs can be adjusted to remain relevant and continue driving improvements in patient care. If effective, their application can extend to other areas of pharmacy practice, including different outpatient specialties, with necessary adjustments. Additionally, the gathered data can help identify future research opportunities, such as developing new cpKPIs for emerging treatments or specific patient populations.

Implementation Process of AOcpKPIs

The final 14 consensus AOcpKPIs will be utilized in the next phase of this project, focusing on implementing, measuring, and optimizing their use to enhance the quality of care in ambulatory oncology pharmacy. The first step in this process is to develop a comprehensive

knowledge mobilization guide for ambulatory oncology pharmacists, including definitions, measurement methods for each AOcpKPI, and instructions for integrating them into daily workflows, similar to the knowledge mobilization guide by Fernandes et al. (2015)¹⁵.

Additionally, training programs such as workshops, webinars, or online modules may educate pharmacists on the significance of these AOcpKPIs, their application and measurement, and effective documentation of interventions.

In addition, the second step: collaborating with healthcare institutions, pharmacy associations, and regulatory bodies to promote the adoption of AOcpKPIs across Canada can be conducted concurrently with the first. Presenting the benefits of these metrics to key decision-makers and evaluating their long-term effects on patient outcomes such as medication adherence, symptom management, and quality of life will be essential. Partnering with national organizations like CPhO could further encourage widespread adoption, potentially establishing these AOcpKPIs as a national standard for ambulatory oncology pharmacists. Additionally, focus groups could provide a platform for pharmacists to share their experiences, challenges, and best practices in implementing the AOcpKPIs.

The third step involves measuring and monitoring the impact of these AOcpKPIs. To facilitate documentation, the AOcpKPIs could be integrated into existing pharmacy management systems or electronic health records, possibly through mobile apps to simplify data entry. Pilot programs can be initiated in selected institutions to test their integration into practice, identify barriers, and refine the implementation process based on feedback. Data on pharmacist interventions could be collected and analyzed regularly to assess the impact of these AOcpKPIs on patient outcomes. Dashboards could visualize progress over time and facilitate continuous monitoring. This data may also enable organizations to develop effective plans and respond

promptly to areas of pharmacy practice needing additional resources, such as staff, training, or technology.

The fourth step involves refining the AOcpKPIs based on collected data to ensure they remain relevant and achievable. Regular engagement with stakeholders may be essential for updating the AOcpKPIs as new evidence and practices emerge. To address barriers to implementation, such as workload and documentation burdens, solutions like mobile AOcpKPI documentation tools may be developed.

Building on these collaborative efforts, it is essential to consider lessons learned from previous implementations of KPIs/cpKPIs in different settings. A study by Minard et al. (2016) explored the implementation of cpKPIs in acute care and highlighted valuable insights that can enhance our approach.⁶² While the study identified areas such as documentation processes, workload management, environmental factors, and competing priorities, these challenges also present opportunities for improvement.⁶² Pharmacists reported some difficulties in consistently tracking cpKPIs, but their feedback underscored the importance of accurate documentation for their interventions.⁶² The challenges and barriers identified in this study could serve as valuable discussion points in focus groups aimed at exploring strategies to overcome these obstacles during the implementation of AOcpKPIs in this project. The team involved in this study already had experienced pharmacists and technical assistance in place to track/document cpKPIs the next phase of this project could look into the recruitment of experienced pharmacists to aid in the implementation process of AOcpKPIs in this project.⁶²

By following these implementation steps, the AOcpKPIs could become a powerful tool for advancing the role of pharmacists in ambulatory oncology, ensuring their contributions to patient care are consistently measured, recognized, and optimized for better health outcomes.

Conclusion

In conclusion, the modified Delphi process established a refined set of 14 evidence-informed AOcpKPIs through consensus among 16 new and experienced pharmacists in Canada. This iterative methodology incorporated diverse professional insights, enhancing the relevance and practicality of the AOcpKPIs while aligning with the latest advancements in the field. These AOcpKPIs offer potential impacts in promoting consistency, quality, and accountability in care, and informing resource allocation decisions. Moving forward, researchers can create knowledge mobilization guides and training programs to empower pharmacists in integrating these indicators into clinical practice. This initiative not only elevates the role of ambulatory oncology pharmacists but also ensures their contributions are systematically measured and recognized, ultimately enhancing the quality of patient care in ambulatory oncology pharmacy in Canada.

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APPENDICES

Appendix A: Evidence Summary Tables

1. Article : Maleki, S., Glewis, S., Fua, T., Liu, C., Rischin, D., Alexander, M., Na, L. Lingaratnam, S. A randomised controlled trial of clinical pharmacy intervention versus standard care to improve medication adherence in outpatients with head and neck cancer receiving radiotherapy. <i>Support Care Cancer</i> 30 , 4243–4253 (2022). ³²		Prepared by: Lauren Hutton and Mike Leblanc (secondary review by Tom McFarlane)
A. Study objective	B. Intervention	C. Main results
Extrapolated practice question: - What is the impact of an outpatient clinical pharmacy service on medication adherence and symptom burden in cancer patients. Study objective: “Evaluate the impact of an outpatient clinical pharmacy service on medication adherence and symptom burden in cancer patients.”	Intervention: - Pharmacist was integrated part of radiotherapy outpatient team. Pharmacist delivered the multidisciplinary designed, evidence-informed pharmacist-led Pharmaceutical Care Program (PCP) - PCP was delivered over at least 4 sessions with clinic pharmacist (at least 2 more than standard of care which includes 2 sessions). Additional sessions beyond 4 were based on identified individual patient requirements. PCP included: 5) Conduct and document accurate and comprehensive BPMH. 6) A) Identification and resolution of medication-related risk factors AND B)	181 patients eligible, 144 randomized, 12/71 in intervention arm did not complete second assessment (refused interview) vs 17/73 in control arm (13 refused interview, 4 unwell/unable to interview) - Intervention arm – n = 59 completed study - Control arm – n = 56 completed study Primary endpoint: medication adherence (MUSE and Teach-Back assessment) – change from baseline to follow up [AHRQ level 3] - MUSE (Medication Understanding and Use Self-Efficacy) scale [higher score = better outcome] – mean MUSE score difference at radiotherapy discharge was 2.7 favouring the intervention (Stat Sig difference). MUSE score decreased in control arm from baseline to discharge (29 to 27) and was maintained/increased in the intervention arm (30 to 31). Min / Max MUSE score at follow up in control arm was 8 / 32 vs intervention arm 22 / 32 (less variance seen in intervention arm vs control). - Teach-back assessment [higher score = better outcome] – control arm teach back assessment

		Monitoring of treatment related toxicities (with recommendations for changes made to radiation oncologist to improve symptom control and optimize route of administration – <i>pharmaceutical care plan</i>) 7) Pharmacist patient (patient or caregiver) education 8) Development of individualized medication adherence aids (adapted to patient health literacy level) Control: - Standard of care provided: 2 assessment interviews by pharmacist (baseline – weeks 1 to 2) and at discharge from radiotherapy service (weeks 5 to 6). - Able to access pharmacy services – limited to individual patient referrals to outpatient dispensary or medicines information service.	was unchanged from baseline to discharge (3.1 to 3.0). intervention arm teaches back score increased from baseline to discharge (3.4 to 4.3). Teach-back score of ≥ 4 decreased in control group from baseline to charge (18% to 14%) vs increased in intervention arm (25% to 86%). (Stat Sig difference). Secondary endpoint: symptom burden [AHRQ level 2] Although NOT Stat Sig difference, the ESAS (Edmonton Symptom Assessment Scale) score was « better » (lower if better and higher if better) across all symptom categories for the intervention arm. Greatest impact seen in areas of general well being, tiredness, drowsiness, and « overall ».
D. Design	E. Patient population	F. Targeted outcomes and endpoints	G. Authors' conclusions

• Prospective • Parallel RCT (1:1) • Non-pharmacy clinical staff (oncologist, nursing, allied health) blinded to the intervention. • Single centre – cancer centre for adults • Clinic pharmacist administered study assessments and delivery of interventions. • N = 115 patients • Location: 1 hospital, Australia • Duration and follow up not included.	Inclusion: • Patients 18 years or older • Newly starting radiotherapy +/- concurrent chemotherapy • Radiotherapy dose of at least 40 Gy Exclusion: • Barriers for communication evident • Already enrolled in another clinical trial Baseline characteristics: • Table 1 includes all important criteria. • Overall, more metropolitan (66%) patients vs regional (34%). • Most patients had stage 1 to 3 disease (56%) • 2 patients (4%) in control arm received concurrent chemotherapy vs none in intervention arm. • Control and intervention groups are similar, with the following exceptions: more medication use in the	Primary outcome: medication adherence as assessed by Medication Understanding and Use Self-Efficacy (MUSE) scale and Teach-Back assessment. Secondary exploratory outcome: patient-reported symptom burden assessed by the Edmonton. Symptom Assessment Scale (ESAS) Statistical analysis: • Used per-protocol-analysis – patients who did not complete the second evaluation (at discharge from radiotherapy) were not included. • Powered (using 2-sided, type 1 error rate of 5%) to detect a three-point difference in MUSE score and 30% difference between proportion of patients with ≥ 4 between arms in Teach-Back assessment at discharge. • Conducted linear regression to assess for univariate factors associated with each outcome. Primary outcome: • Medication adherence was assessed according to two indices: the Medication Understanding and Use Self-Efficacy (MUSE) scale to	• “The outpatient clinic pharmacist working within a multidisciplinary radiotherapy clinic produced a clinically meaningful improvement in patient understanding of medicines information and patient adherence to medication instructions, and reduction in the overall cancer disease and treatment-related symptom burden.”
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	intervention arm (12 [20%] vs 5 [9%]), more HPV + patients in intervention arm (26 [44%] vs 17 [30%])	measure patients' behaviours towards medication adherence, and objective patient Teach-Back assessment scores collected by the pharmacist verifying patient understanding of medicines information and use. Secondary outcomes: • Patient reported outcomes relating to symptom burden were also assessed using the Edmonton Symptom Assessment System (ESAS). Statistical analysis: • All analyses included patients who completed assessments at both baseline and discharges. • Powered (2-sided type 1 error rate of 5%) to detect at discharge, a three-point difference in MUSE score and 30% difference between arms in the proportion of patients with Teach-Back score of four or more. • Linear regression models adjusted for their score at baseline were used to compare allocation arms in MUSE and ESAS scores at discharge.	
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Strengths	APPLICATION/SYNTHESIS: How does this study inform the AOcpKPI selection process (methods, AOcpKPI selection criteria, and candidate AOcpKPI)?
• RCT linked to meaningful AHRQ level 3 and 2 patient outcomes. • Small sample size (n = 115) • Unit of randomization was patient, and not ward or team. • Clinically appropriate follow up duration (length of treatment) • Intervention was comprehensive and adaptable, reflective of real-world practice. • Intervention was described in enough detail to replicate, and time commitment was logged. • Intervention was practical and authentic to the services pharmacist's desire to provide. • Bundled intervention reflective of real-world practice. • Randomized, controlled trial. • Used MUSE for adherence assessment and patient reported symptom burden was assessed using ESAS. ○ All established tools to assess the desired outcome. • Used Teach-Back (well known teaching technique) to assess comprehension. First study to do so. • Same pharmacist did all the assessments. • Randomization was effective in achieving comparable groups.	• One of only a few RCTs looking at impact of true pharmaceutical care on AO outpatients. • Intervention was a bundle of critical elements and represented comprehensive pharmacists' services provided to patients from radiotherapy initiation to completion/discharge. • Highlights the impact of pharmacists as part of the health care team, and their influence on patient outcomes. • Pharmacist-led pharmaceutical care may improve medication adherence and patient self-efficacy. The medications studied were not systemic anticancer therapy (in all but 2 patients); largely supportive medications or for management of comorbidities). There was no description of radiotherapy dose intensity was reported. • Patients received the critical elements as a bundle, which included pharmaceutical care and services such as medication reconciliation, drug review to identify and resolve DTPs, patient education, and monitoring. • The independent critical elements (i.e., patient education) used in this study may serve as surrogate markers for reduced morbidity (health resource utilization) or quality of life (improved symptom burden). Mortality measures would require longer duration of follow up.

	• We must be cautious about extrapolating the results of this study to other treatment methodologies beyond radiotherapy. • Potential denominator metrics for AOcpKPI could include total number of patients newly starting on treatment. • RCT evaluating the impact of structured interventions including BPMH, toxicity assessment and education on patient adherence to medications as well as symptom burden. • Intervention was a bundle of possible activities that could be identified as KPIs. • Outcomes are meaningful and measurable in general practice so may be valuable to select other candidate KPIs. • Highlights the impact of pharmacists as part of the health care team, and their influence on patient outcomes.
Limitations	What are the patterns (similarities and differences) compared to other key papers?
• Generalizability ○ Only two patients on concurrent chemo-radiotherapy. May not be able to generalize to patients on systemic anticancer therapy. ○ Not multi-centre, study done in 1 hospital. ○ Australian health care system • Limitations with blinding: ○ The only “unblinded” participant – the clinic pharmacist – did the intervention and assessment which may have introduced assessor bias or patient social desirability bias. ○ Blinding of other practitioners not described and may have been difficult to achieve in reality as the pharmacist made all recommendations for pharmacotherapy optimization	Similarities: • Rate of medication adherence has been an outcome measured in many of the key papers including Quinn, Oliviera and Caracul. ○ Maleki group used MUSE tool (a predictive tool of an intention to perform a given behaviour) to assess adherence rates. ○ There are no clear, consensus tool used to measure adherence rates.

to the treating radiation oncologist (i.e., if occurring at times other than baseline and discharge, would infer the patient is in intervention arm). • No description of radiotherapy treatment dose intensity the patient was able to receive secondary to receiving the pharmacist services (what is the link between radiotherapy dose intensity and treatment outcomes?). • Medication adherence measure of non-systemic anticancer therapy not as clearly linked to surrogate outcomes of improved morbidity/mortality/QoL (AHRQ level 1). • Need for validated tool to assess patient comprehension. • Not powered to show statistical difference for healthcare system utilization. • Although randomized, the groups did differ in the number of participants who had a “carer” supporting them. This may have explained the differences in adherence and will need to be confirmed in future studies.	Similar somewhat to the Myers paper that directly compared a standard of care with reactive/minimal pharmacy services to a more comprehensive and proactive clinical pharmacy program (bundled intervention). Differences: • Only study evaluating role of pharmacist in patients receiving radiotherapy exclusively. • One of only a few RCTs included looking at this research topic. • Limited generalizability to patients on systemic anticancer therapy
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2. Article: Nishibe-Toyosato S, Ando Y, Goto Y, Hayashi T, Ito K, Matsuda H, Tsujii N, Tsuge M, Kawada K, Imaizumi K, Yamada S. The Influence of Intervening on the Pharmaceutical Consultation Targeting Outpatients with Advanced Non-small Cell Lung Cancer Receiving Erlotinib Treatment. Biol Pharm Bull. 2021 Sep 1;44(9):1280-1285.³⁷		Prepared by: Lauren Hutton (secondary review by Tom McFarlane)
A. Study objective	B. Intervention	C. Main results
Extrapolated practice question: - Does pharmaceutical consultation for patients receiving erlotinib for NSCLC treatment impact adverse effects and/or relatively dose intensity? Study objective: “Evaluate whether pharmaceutical consultation targeting outpatients affect the treatment efficacy of erlotinib.”	Intervention: - Patients who received interventions by pharmacist in outpatient consultation within 2 months after initiating erlotinib - performing the following procedures: explanation of treatment regimens and schedule; interviewing patients regarding adverse events associated with anti-cancer drugs to provide lifestyle guidance and appropriate use of these drugs as well as recommending supportive care; confirming of examination results on the same day; confirming of drug interactions; adjustment of prescription days according to the number of remaining drugs; recommendation for additional examination and of receiving concomitant treatment with another department; and proposal for changes and/or discontinuation in/of dose regimens of anti-cancer drugs. Interventions by a pharmacist are performed prior to a physician consult	93 patients eligible, 33 participated 15 intervention group, 18 control/non-intervention group. - The intervention group (97.6% [78.1–100.0]) had a statistically significantly higher median RDI than the non-intervention group (71.4% [56.3–85.9]) (p = 0.0437) - the pharmaceutical consultation targeting outpatients was identified as a statistically significant factor contributing to the maintenance of RDI ≥90% (p= 0.026) - The intervention group (547 [95% CI, 339–PFS was not reached] days) tended to be longer median PFS than the non-intervention group (305 [95% CI, 227–474] days), although no significant difference was observed

		to present the patient's information to doctors. - N = 15 Control: - Usual care (no pharmacist intervention within 2 months of initiating erlotinib) - N = 18	
D. Design	E. Patient population	F. Targeted outcomes and endpoints	G. Authors' conclusions
- Non-randomized controlled "before and after" study. - Retrospective - Data collected retrospectively from patient electronic health records. - Single centre - N = 33 patients - Location: 1 hospital, Japan. - Duration: July 2015 to March 2019	Inclusion: - Patients with NSCLC who received erlotinib for more than 6 months. Exclusion: - EGFR mutation status negative or unknown - Induction dose or erlotinib was other than 150 mg/dose. - Initiated erlotinib at a hospital other than the study site Baseline characteristics: - Table 1 includes limited data and is specific to patients NSCLC history with limited	Outcomes: - Relative dose intensity = calculated by dividing the actual dose [erlotinib prescriptions × erlotinib treatment days] by the standard dose [150 mg × erlotinib treatment days] - Progression free survival = time between the date of erlotinib induction and the date of first documented progressive disease (PD) or death from any causes, whichever occurred first Statistical analysis: - Chi-squared test, fishers exact test, and Mann-Whitney U tests used in specific descriptive data scenarios.	"There was improvement in RDI with pharmaceutical consultation targeting outpatients with advanced NSCLC; however, enough evidence was not provided about PFS."

(intervention) and December 2007 to March 2019 (control) Follow-up: duration of first 6 months on erlotinib therapy	information about other patient characteristics. - Study size very small so groups look imbalanced at baseline. Clinical relevance hard to discern. - Greater proportion of patients in control group had 3 or more lines of prior treatment (22% of 18) vs intervention arm (0% of 15). Half of patients (46.7% of 15) in intervention arm received concomitant treatment with bevacizumab vs control (5.6% of 18). EGFR mutation status for Exon 19 vs 21 different between arms with dominance in control arm and intervention arm respectively.	- Univariate and multivariate analyses used to identify factors influencing relative dose intensity of erlotinib. - Kaplan-Meier, log-rank, and Cox-proportional hazard regression models used to calculate PFS curves, median PFS, and HRs.	
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Strengths	APPLICATION/SYNTHESIS: How does this study inform the AOcpKPI selection process (methods, AOcpKPI selection criteria, and candidate AOcpKPI)?
• Meaningful AHRQ level 2 patient outcome – relative dose intensity of erlotinib helps maintain systemic exposure of drug which is linked to improved treatment outcomes (morbidity/mortality). • Hypothesis generating for level 1 outcome of improved PFS (not stat sig). • Conducted multiple univariate analyses to assess for independent factors contributing to outcome of RDI. • Intervention activities were described in enough detail to replicate the bundled services (although not enough detail related to timing/frequency/follow up logistics) • Intervention bundled activities authentic to the services pharmacist’s desire to provide	• Intervention was a bundle of critical elements and represented comprehensive pharmacists’ services provided to patients in outpatient oncology setting. • Intervention aimed to prevent well described dose limiting toxicities (dermatologic) - proactive. • This study may provide some early hypothesis generating results related to pharmacist intervention and creating a stronger link between RDI and treatment outcomes such as PFS. • Unbalanced groups at baseline and small sample size limit the potential conclusions that could be drawn from this paper, but it provides additional evidence that there may be a link between the described pharmacist intervention activities, in a bundled format, and RDI. Would warrant a more robust, prospective study asking the same question/outcomes – strong rationale to investigate this relationship further. • On its own this study would not be practice changing.
Limitations	What are the patterns (similarities and differences) compared to other key papers?

• Not powered to detect difference in PFS between groups. • Small sample size • Limited generalizability with a focus on one medication (erlotinib) for a single indication (NSCLC) and a sub focus on a specific set of toxicities (dermatologic). • Retrospective design may introduce uncharacterized confounders between groups. • No description was provided around referral criteria or logistics related to how patients were identified/selected to receive pharmacist services (or what informed when the pharmacist became involved) • Groups not balanced with regard to concomitant administration of bevacizumab (higher rates in intervention arm) or stage of disease/line of therapy. • No detail provided on how often the pharmacist interacted with patients (if any standardized times or all individualized). • Single centre study in Japan (care models and populations may vary vs Canadian and limits generalizability)	Similarities: • small sample size, retrospective observational cohort design • bundled intervention. • evidence to support positive impact of pharmacist on treatment tolerability. Differences: • study specific to a single drug, focusing on dermatologic toxicities. • included calculation on relative dose intensity. • Lower quality study methodology, some hypothesis generating for higher level patient outcomes such as level 1 (PFS) and level 2 (RDI).
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3. Article: Oliveira CS, Silva MP, Miranda ÍKSPB, Calumby RT, de Araújo-Calumby RF. Impact of clinical pharmacy in oncology and hematology centers: A systematic review. J Oncol Pharm Pract. 2021 Apr;27(3):679-692.³⁸

Prepared by: Lauren Hutton (secondary review by Tom McFarlane)

A. Study objective	B. Main results
Extrapolated practice question: - What evidence exists that describes the impact of clinical pharmacy interventions for patients being treated for a hematologic cancer? “What is the impact of the implementation of Clinical Pharmacy services in onco-hematology centers?” Study objective: “To evaluate, synthesize and critically present the available evidence on the impact of the Clinical Pharmacy in the treatment of patients with hematological cancer. The articles were investigated according to the outcomes, such as: - Drug-Related Problems (DRPs) and interventions, - Humanitarian impacts (improvement of quality of life and patient education and counseling) - Economic impacts (reduction of hospitalization costs and cost of inappropriate therapies)	Studies: - Systematic review 745 publications were identified, however only 17 met the inclusion criteria (4771 patients) [number of publications identified in text does not match figure 1] - Primary disease types studied in included articles = CML and lymphomas Assessed studies according to common themes and grouped them together based outcome themes of DRPs, humanitarian impact, and economic impacts. - DRPs (17) - humanitarian impact (3) (improvement of QoL and patient education and counselling) - economic impacts (2) (reduction in hospitalization costs and costs of inappropriate therapies) – inpatient pharmacist services cost impact analysis Methodologies included: (9 prospective, 8 retrospective) - qualitative and descriptive analysis (8) - impact assessment (6)

		- cohort analysis (2) - cross-sectional (1) Results: select statements that represent key generalizations from the systematic review • pharmacotherapy evaluation resulted in 3000 therapeutic interventions and identification of ~1500 DTPs (no link to patient outcomes – descriptive in nature)
C. Design	D. Study inclusion	E. Authors' conclusions
• Systematic review • N = 17 studies • Location: worldwide • Language: English • Timeframe : July 1999 to May 2020	Inclusion: i) original research articles (e.g., regarding randomized controlled trials, non-randomized controlled studies, cohort studies, cross-over studies, and before-and-after studies) published between 1999 and 2019. ii) published in Portuguese, Spanish or English. iii) having evaluated a clinical pharmacy service at an onco-hematology center; and iv) having patients with hematologic cancer as a population Exclusion: i) studies that did not consider the treatment of onco-hematologic tumors.	• “The practice of clinical pharmacy and pharmaceutical care has shown that cancer patients accompanied by a clinical pharmacist, showed higher adherence to treatment, control of symptoms (e.g., cancer pain, nausea, constipation), improvement in quality of life, as well as reduction and/or solution of DRPs.” • “Clinical pharmacy services contributed to the individualization and monitoring of therapeutic regimens.” • “It contributed to patient and health service by reducing hospitalization time and unnecessary expenses, helping to achieve the goals established by multiprofessional team.” • “Suggest future longitudinal studies by carried out to clarify impact of clinical pharmacy and pharmaceutical care on survival and quality of life”

	ii) articles with study designs out of interest such as cases studies and literature review Inclusion process: • No description of who conducted or assisted with the literature search (research team + or – medical librarian?) • “all findings considered by 3 independent reviewers” but not specified if this was search results, data extraction, other? • No mention of how data extraction and analysis were performed. Search question: P - patients with hematological cancer I- the practice of pharmacotherapeutic monitoring by pharmacists as the intervention of interest. C - not performing the service as baseline. O - the results of the applied interventions as outcome. Databases searched: - PROSPERO and Cochrane databases (for SRs) - PubMed/MEDLINE, - Latin American and Caribbean Literature in Health Sciences (LILACS) - Google Scholar - articles were identified from the reference lists of the included studies.	
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	Search strategy: {"Clinical Pharmacy" OR "Pharmaceutical care" OR "Pharmacotherapeutic Follow-up"} AND {"Oncology" AND "Hematology"} OR "Oncohematology"}	
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Strengths	APPLICATION/SYNTHESIS: How does this study inform the AOcpKPI selection process (methods, AOcpKPI selection criteria, and candidate AOcpKPI)?
• Focused methodology (given the challenge of the heterogeneous studies in this qualitative review) ○ Well described systematic search strategy ○ All findings were considered by three independent reviewers to ensure consistency in execution of the review process. • Described some of the pharmacist interventions of the included studies in the results section. Helpful for context. Would have been ideal to include pharmacist intervention activities in the article review table to provide context. • Included articles published in multiple languages (not just English)	• Highlights general areas of pharmacy practice or clinical services and the related pharmacy services that have been deployed and characterized there, extracted from heterogeneous literature, largely related to pharmacist output outcomes. • Hypothesis-generating –largely descriptive of service delivery and not patient outcomes.
Limitations	What are the patterns (similarities and differences) compared to other key papers?

Individual studies included in the review were heterogeneous:

- Range of sample sizes, ranging from n = 16 to n = 1443 (11/17 studies had > 100 pts)
- Many of the studies descriptive of pharmacist output (DTPs, education, adherence counselling, toxicity monitoring and management) and not focused on patient level outcomes.
- Not exclusive to ambulatory care (included trials related to inpatient services as well)
- Focused predominantly on hematology malignancies.

Methodology of systematic review:

- Included non-randomized studies.
- Included retrospective assessments.
- AHRQ level 2 clinical outcome
 - Patient adherence:
 - Lam MS and Cheung N. Impact of oncology pharmacist managed oral anticancer therapy in patients with chronic myelogenous leukemia. J Oncol Pharm Pract 2016; 22:741–748.).
 - Ribed A, Romero-Jimenez RM, Escudero-Vilaplana V, et al. Pharmaceutical care program for onco-hematologic outpatients: safety, efficiency, and patient satisfaction. Int J Clin Pharm 2016; 38: 280–288.
- Differing interventions, outcome measurements, and definitions
 - DRPs, ADE, ADR, medication errors, pharmaceutical care process

Similarities:

- Core focus on pharmacist output (DRPs) vs patient level outcomes.
- Describing benefit of pharmacist intervention on medication adherence in two studies

Differences:

- Systematic review, heterogeneous methods and research questions of included articles
- Some description of pharmacist interventions across the different studies but this was not a focus of the review so limited data available from this manuscript directly.
- Described impact of pharmacist intervention on cost (primarily inpatient)
- Included inpatient and outpatient articles

4. Article: Zhang, L., McLeod, H., Liu, Ke-Ke., Liu, W., Huang, H., Huang, Y., Sun, S., Chen, X., Chen, Y., Lui, F., Xiao, J. Effect of physician-pharmacist participation in the management of ambulatory cancer pain through a digital health platform: randomized controlled trial. MIR Mhealth UHealth. 2021 Aug;9(8):e24555. Published online 2021 Aug 16. ⁵⁰			Prepared by: Jason Wentzell (secondary review by Tom McFarlane)
A. Study objective	B. Comparison	C. Main results	
- Assess self-management of cancer pain in ambulatory patients using an eHealth platform (MediHK) supported by pharmacist/physician collaboration. ‘We aimed to assess whether the joint physician-pharmacist team operating through MediHK would provide better self-management of ambulatory patients with cancer pain and optimize therapeutic outcomes.’	Intervention: Pharmacist reminders to complete pain/symptoms surveys and implementation of an eHealth portal (MediHK) - Pharmacist assessed: pain intensity and impact on daily life, medication reviews, toxicity/ADR, adherence. - Pharmacist would review medications/survey scores and relay recommendations for dose optimization to doctors. - Targeted education to patients based on perceived knowledge deficits. Control: - Patients randomized to joined in the MediHK only, no physician-pharmacist active intervention but pharmacist and physician care available. No reminders or notifications to complete surveys.	- Pain intensity - Worst, least and average pain scores were all statistically different, favoring intervention vs. control at study conclusion. - Pain interference in activity, mood and relationships was numerically but not statistically improved between 2 groups. - PROM form submission was higher in the study (reminded) group 710 vs 95 in the control group (no reminders) - Adherence improved the medication adherence rate increased from 43% to 63% in the intervention group, compared with an increase of 33% to 51% in the control group ($P<.001$). Rehospitalization rates were similar between the 2 groups.	

D. Design	E. Patient population	F. Targeted outcomes and endpoints	G. Authors' conclusions
• RCT • 4-week study • Tertiary hospital in China • Ambulatory patients	• N = 100 • 51% in intervention group • 49% in control (standard of care)	Primary outcome: • Pain intensity & interference with daily life (Brief pain index) • ADRs • Rehospitalization • 24-hour pain diary • Q 3 daily ADR assessment forms • Q 15-day Brief Pain Inventory	• The joint physician-pharmacist team operating through MediHK improved pain management. This study supports the feasibility of integrating the internet into the self-management of cancer pain.

Strengths	APPLICATION/SYNTHESIS: How does this study inform the AOcpKPI selection process (methods, AOcpKPI selection criteria, and candidate AOcpKPI)?
• Innovative digital practice • Pharmacist-coordinated intervention • Ambulatory oncology setting • Concept could be widely implemented. • Demonstrated improved adherence with study intervention. • Improvement in pain intensity for intervention • Promoted patient engagement.	• Pharmacists in this study reviewed patient pain score submissions from an electronic eHealth platform. • They were familiar with patient medications and PMHx and made dosing recommendations (that needed to be approved by MD) to optimize patient pain scores. • They monitored for and addressed ADRs. • DTPs dose adjustments to optimize pain control

• AHRQ level 1 - morbidity/mortality/QoL	
Limitations	What are the patterns (similarities and differences) compared to other key papers?
• Real randomization was to the ‘reminders’ that the eHealth system generated and not to the system itself. • Generalizability ○ Not multi-centre, study done in 1 hospital. ○ Chinese health care system (although international collaborators) • Randomization not explained (although groups balanced) • No impact on hospitalization • No reporting on mortality • Not an independent intervention by pharmacists (required physician concordance for dose changes)	Similarities: • It was similar in theme in others in that pharmacists led a patient monitoring initiative and made dose recommendations to optimize and intervention (in this case pain control) Differences: • This was a relatively unique intervention. • Identification of DTPs (pain control) enhanced through eHealth reminders. • Focus on cancer pain (only one other study with same focus)

5. Article: Myers, G., Stevens, J., Flewelling, A., Richard, J., London, M., Evaluation and clinical impact of a pharmacist-led, interdisciplinary service focusing on education, monitoring and toxicity management of immune checkpoint inhibitors (2023) ⁵⁴			Prepared by: Jason Wentzell (secondary review by Tom McFarlane)		
A. Study objective		B. Comparisons		C. Main results	
- To determine the impact and spectrum of patient care interventions performed by ambulatory pharmacists providing care for patients taking immune checkpoint inhibitors (ICIs) - Compare a pharmacist-involvement in an ICI clinic to another regional centre without the same involvement. - To quantify/qualify pharmacist interventions (immune related (ir) AEs, irAE monitoring and management)		Intervention: - Intensive oncology pharmacist-based education/intervention offered collaboratively within an interdisciplinary team. - Included: ICI and irAE education prior to treatment initiation with a focus on identification of irAE ‘red flag’ symptoms and summary of ICI resources - Plus, proactive phone follow-up prior to first 3 cycles - Collaborative irAE management with oncologist/nursing staff Comparison: - No proactive pharmacist intervention		- In total, 1664 pharmacist interventions were performed across the 11 categories. - Supportive care recommendations were common. - Pharmacists facilitated significant interventions through referral for escalating symptoms, systemic immunotherapy recommendations and medication adjustments. 92 patients from each of the cancer centres were included in the matched cohort. - A higher odds of treatment discontinuation due to irAE(s) was identified in patients who did not receive dedicated pharmacist follow-up in the control cohort compared to the study cohort. - There was no difference in the proportion of finite PD-1, or PD-L1 inhibitor treatment courses completed between the two sites	
D. Design	E. Patient population	F. Targeted outcomes and endpoints		G. Authors’ conclusions	
The first part of the study employed a	- N=143 - Ambulatory oncology patients receiving ICI-based therapies (atezolizumab, cemiplimab,	- Total ED visits not resulting in admission to hospital. - Hospitalizations due to suspected irAE(s) (not including new irAE(s))		Frequent monitoring, early recognition, and collaborative management of irAEs are an emerging role for the clinical pharmacist as the use of ICIs continues to expand.	

retrospective chart review to track pharmacist interventions in the study cohort (11 a priori intervention types) The second part of the study used a retrospective matched cohort design, where the study cohort was matched 1:1 with the control cohort	durvalumab, ipilimumab, nivolumab, pembrolizumab) - January 2016-August 31, 2019 - NOT clinical trial patients	while admitted to hospital for another reason) - ICI treatment discontinuation due to irAE(s) - Total ICI cycles received. - Completion of PD-1 or PD-L1 inhibitors with a finite treatment course - Reporting on 11 key categories of pharmacist intervention	- Preventing ICI treatment discontinuation prolongs exposure to evidence-based drug therapy proven to improve cancer outcomes such as overall survival, progression-free survival, and response rate. - There was no single pharmacist recommendation that prevented ICI discontinuation due to irAEs, but rather, a comprehensive pharmaceutical care strategy centred around proactive follow-up, outpatient management and improved healthcare accessibility to the patient. [This] study contributes to the growing body of evidence detailing the role of the clinical pharmacist in managing ambulatory oncology patients treated with ICIs. - Dedicated, proactive pharmacist follow-up contributes to the early identification, grading and appropriate management of irAEs which improve patient outcomes
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who received ICI treatment during the same time period.			
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Strengths	APPLICATION/SYNTHESIS: How does this study inform the AOcpKPI selection process (methods, AOcpKPI selection criteria, and candidate AOcpKPI)?
• Innovative pharmacist practice • Demonstration of significant value • Comprehensive, proactive, collaborative care model for patients starting ICIs. • Interventions clearly made by and exclusive to pharmacists. • Detailed intervention, an incredible standard of pharmacist care • Practical avenue to real-life ‘red flag’ irAE reporting and patient support • Standardized assessments performed. • Rationale provided as to why a second site (vs primary site) was used as the control cohort provided. • Matched cohort process well described/justified. • Described meaningful level 1 AHRQ patient outcomes (ER visits, hospitalizations) and level 2 AHRQ patient outcomes (toxicity, Tx discontinuation etc)	• Shows some of the outcomes that could be positively affected by pharmacists. • Did not provide detailed account of what specific pharmacist patient care activities were used to produce these outcomes. • Findings may not support a specific pharmacist patient care activity, rather highlights that pharmacist involvement in direct patient care in general improves certain patient outcomes (ie. HbA1C, LDL cholesterol, blood pressure) • Extrapolation of findings may highlight 3 very specific areas of focus, with stronger evidence of pharmacist impact: 1) DM, 2) hyperlipidemia, and 3) hypertension.

	Suggests that pharmacists can impact all levels of AHRQ patient outcomes.
Limitations	What are the patterns (similarities and differences) compared to other key papers?
- Retrospective chart review (relied on documentation that seemed pretty standardized) - Quite a wide range for study timeline so practices/documentation may have varied slightly over time (minimal limitation addressed in study) - Intervention compared to a cohort from a different institution (explained in the paper, likely not overly significant – similar funding, treatment lines, Province & matched)	Similarities: - A retrospective review of planned, proactive interventions - Clearly describes 11 a priori interventions that include assessing/addressing DTPs, teaching/education, interdisciplinary communication, documentation, medication review etc. - Clear description of pharmacist-specific impact Differences: - Case controlled, site-based cohort study. - Comparison and demonstrated benefit of a pharmacist-based intervention vs. a non-pharmacist-based control. - Assessment of level 1 AHRQ patient outcomes of morbidity (health care utilization) - Only study evaluating treatment discontinuation rates. - Canadian study

6. Article: Joy AM, Up N, Chand S., Shetty, J., George, S., Chacko, C., Joel, J. Role of clinical pharmacist in the medication adherence behaviour of cancer patients: an interventional study. Le Pharmacien Hospitalier et Clinicien 2021;56:291-297.⁵³

Prepared by: Shirin Abadi (secondary review by Tom McFarlane)

A. Study objective	B. Intervention	C. Main results
To assess the impact of patient counselling on medication-taking behaviour of ambulatory cancer patients	Intervention: • information leaflets and face to face medication counselling from clinical pharmacists at the beginning of the 6th month study • Assessment was done, using a validated 8-item Morisky medication adherence scale, at baseline and final follow up: • First 7 items dichotomised as “Yes” (score = 1) or “No” (score = 0) • Last item scores frequency of patient having difficulty remembering to take medications, as Never (score = 4), Once in a while (score = 3), Sometimes (score = 2), Usually (score = 1), All the time (score = 0) • Sum of all answers calculated: ○ Score less than 6 = low adherence ○ Score 6 – 7 = moderated adherence ○ Score 8 = high adherence Control: • information leaflets and face to face medication counselling from clinical pharmacists at the END of the 6th month study “The well-being of all the patients was enquired verbally during all their visits to the hospital and they were reminded about their medications through telephone to provide psychological support and to establish a better relationship” -? follow up?	• Mean $\pm$ S.D. for medication adherence at baseline: ○ Intervention group: 6.461 ± 1.36 ○ Usual care group: 6.65 ± 1.69 • Mean $\pm$ S.D. for medication adherence at follow up: ○ Intervention group: 7.715 ± 0.509 • Usual care group: 6.67 ± 0.901 Data analysis: • Mean values in intervention and usual care group were compared using independent t-test. • Descriptive statistics (mean $\pm$ S.D.) were used to summarize the data. • Chi² test and Fishers exact test were used for additional data analysis. • Statistical significance was set at $P < 0.05$.

D. Design	E. Patient population	F. Authors' conclusions
• Prospective, randomized (Chit method) • Single-centre • N = 130 ambulatory cancer patients • Setting: Outpatient oncology department of a tertiary care hospital • Location: Mangaluru, India • Study duration: 6 months • Submitted: November 2, 2020 • Accepted: May 9, 2021	Participants: • N = 130 ambulatory cancer patients ○ Intervention group: 65 patients ○ Control group: 65 patients • Inclusion criteria: ○ 18 years of age or older ○ Diagnosed with any type of cancer. ○ On at least one oral agent on discharge (assuming antineoplastic agent) • Exclusion criteria: ○ Patients with mental illness Patients with speaking difficulties	• “Pharmacist mediated education and counselling regarding medications among patients with cancer has led to clinical and statistically significant differences in medication adherence behaviour compared to that of the usual care group.” • Patient education and counselling have a considerable role in the well-being of patients, and it is proved to be efficient. It can also provide supportive care and improve confidence and satisfaction among patients.” Authors' discussion points: • “Statistical evidence supports the role of clinical pharmacist counselling in having an impact on medication adherence behaviour of patients”. • Other studies also support pharmacist counselling and education can enhance medication adherence for patients with cancer or chronic diseases.

Strengths	APPLICATION/SYNTHESIS: How does this study inform the AOcpKPI selection process (methods, AOcpKPI selection criteria, and candidate AOcpKPI)?
• The use of the validated 8-item Morisky Medication Adherence Scale (MMAS-8) at baseline and follow up • Inclusion of an intervention group, in addition to a control group (usual care) • Attempt at randomization of patients into 2 groups. • level 2 - surrogate outcomes (i.e., HR/BP)	• Provides support for improvement in adherence as a potential patient outcome for consideration of the AOcpKPI panel.
Limitations of a panel of quality actions • Small sample size (n = 130 patients; 65 patients in each group) • No power calculation mentioned in the study. • Generalizability (international): ○ Study conducted in outpatient oncology department of a tertiary care hospital in Mangaluru, India • Not clear if true randomization occurred, as details lacking: “Patients meeting the study criteria were included in the study and categorized into intervention and usual care group by chit method”.	What are the patterns (similarities and differences) compared to other key papers? Similarities: • There are other studies that support improvement in medication adherence for patients with cancer, when they are counselled/educated by pharmacists, e.g., Birand N, et al study on “The role of the pharmacist in improving medication beliefs and adherence in cancer patients”. J Oncol Pharm Pract. 2019;25(8):1916-1926.

- Table 1 “Patient demographics” missing from the study and therefore difficult to assess such details, as cancer type and stage, cancer medication type, average number of medications, level of education, etc. between the intervention and control groups.
- Not clear about the rigor of patient education provided and quality of educational material used, and if a reliable and standardized approach was used to improve adherence for patients in the intervention group.

Not clear if statistical difference of 1 point in average follow up adherence scores between the intervention and control groups is clinically important, and to what extent it might have been sustained post-follow up.

- It is not surprising to find pharmacist involvement in patient counselling/education can improve medication adherence.

Differences:

- The studies in this field differ in their methodology rigor and the instruments used to measure adherence, and whether any attempts have been made to link medication adherence to improving patient health outcomes for the patient population being studied.
- Seemingly a single intervention study (not bundled intervention as most of the other included research) focusing on patient education at discharge? Vs at the end of the study period.

7. Article: Suzuki, H., Suzuki, S., Kamata, H., Sugama, Y., Demachi, K., Ikegawa, K., Igarashi, T., Yamaguchi, M. Impact of pharmacy collaborating services in an outpatient clinic on improving adverse drug reactions in outpatient cancer chemotherapy. Journal of Oncology Pharmacy Practice 25.7 (2019): 1558-1563. ⁴⁶		Prepared by: Bryanna Tibensky (second review by Lauren Hutton)
A. Study objective	B. Intervention	C. Main results
Extrapolated practice question: - Does collaborative assessment and prescribing - including a clinical pharmacist - improve adverse events in outpatient cancer chemotherapy? Study objective: “To evaluate the impact of a service in which clinical pharmacists collaborate with oncologists at an outpatient clinic on the management of adverse drug reactions (ADRs) in outpatient cancer chemotherapy.”	Intervention: 6 pharmacists collaborated with oncologists at an outpatient clinic for the management of ADRs in cancer patients. - Pharmacist tasks included: - Collects information on patients’ status (ADRs, adherence, medications) - Attends the oncologist outpatient exam. - Informs oncologist of collected information and suggests prescriptions for supportive medications and provides drug information to the oncologist. - Prescription verification of the supportive medications - Counsel patients on supportive medications	- There were 498 pharmacist interventions, with 103 (20%) being treatment suggestions for chemotherapy ADRs. - Average of 1.7 interventions per day per pharmacist - ADRs with the most pharmacist suggested prescriptions included: skin and subcutaneous tissue disorder (28%), constipation (12%), nausea and vomiting (11%), peripheral neuropathy (8%) - Of the 103 prescription suggestions, 82 (79%; 63 patients) were approved by oncologists. - Of the 82 approved prescriptions, 47 (57%) adverse drugs reactions improved.

		Control/comparator: none																																	
D. Design	E. Patient population	F. Targeted outcomes and endpoints	G. Authors' conclusions																																
- Retrospective cohort study (<i>authors describe as cohort; however, it reads as a case series or before/after study</i>) - N=63 - Data sources: medical records and patient-recorded treatment diaries - Duration: June – August 2016 - Single centre - Location: National Cancer Centre Hospital East in Japan	Inclusion: Patients who received outpatient chemotherapy via a clinical pharmacist and oncologist collaboration service Exclusion: None Patient Characteristics: <table><tr><th>Variables</th><th>n (%)</th></tr><tr><td>Gender</td><td></td></tr><tr><td>Female</td><td>20 (31)</td></tr><tr><td>Male</td><td>43 (68)</td></tr><tr><td>Age, median [range]</td><td>70 [36–85]</td></tr><tr><td>ECOG-PS</td><td></td></tr><tr><td>0</td><td>32 (50)</td></tr><tr><td>1</td><td>28 (44)</td></tr><tr><td>2</td><td>3 (4)</td></tr><tr><td>Primary tumor site</td><td></td></tr><tr><td>Hepatobiliary and pancreatic</td><td>21 (33)</td></tr><tr><td>Head and neck</td><td>16 (25)</td></tr><tr><td>Lung</td><td>10 (15)</td></tr><tr><td>Gastrointestinal</td><td>8 (12)</td></tr><tr><td>Breast</td><td>6 (9)</td></tr><tr><td>Other</td><td>2 (3)</td></tr></table> ECOG-PS: Eastern Cooperative Oncology Group Performance Status.	Variables	n (%)	Gender		Female	20 (31)	Male	43 (68)	Age, median [range]	70 [36–85]	ECOG-PS		0	32 (50)	1	28 (44)	2	3 (4)	Primary tumor site		Hepatobiliary and pancreatic	21 (33)	Head and neck	16 (25)	Lung	10 (15)	Gastrointestinal	8 (12)	Breast	6 (9)	Other	2 (3)	Primary outcome (<i>inferred, not specifically stated</i>): - Improvement in adverse drug reactions due to pharmacists' interventions and pharmacists' prescription suggestions to oncologists - ADRs were defined using NTI-CTCAE v4.0 (for 26 [31%] patients) or simply as 'present vs absent.' Secondary outcomes (<i>inferred, not specifically stated</i>): - Frequency of pharmacist interventions - Frequency and classification of pharmacist interventions for ADRs Statistical Analysis: - Descriptive statistics (mean, frequency)	“This is the first study to clarify the benefits of outpatient pharmacy services in which pharmacists collaborate with oncologists at an outpatient clinic for the management of adverse drug reactions in cancer patients in Japan.”
Variables	n (%)																																		
Gender																																			
Female	20 (31)																																		
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Breast	6 (9)																																		
Other	2 (3)																																		

Strengths	APPLICATION/SYNTHESIS: How does this study inform the AOcpKPI selection process (methods, AOcpKPI selection criteria, and candidate AOcpKPI)?
• Wide range of patient ages, oncology conditions and chemotherapy regimens (study used term “chemotherapy” but included oral targeted agents, chemotherapy, hormonal agents, and immune therapy). • Intervention was described in enough detail to replicate. • Intervention was specific to ambulatory oncology practice. • ADRs being considered (by AOcpKPI working group) as a surrogate to QoL unless measuring QoL via validated tool – level 2 AHRQ patient outcome	• Highlights the impact of pharmacists as part of the team, and their influence on a Level 2 AHRQ outcome (adverse events) • This study found that implementation of collaborative pharmacist assessment and prescribing can improve chemotherapy-related adverse events (focus on treatment vs prevention) • This study had a focus on decentralized/patient facing pharmacy services, and less on centralized clinical order verification/distribution activities. • Most components of the intervention were practical and aligned with services that ambulatory oncology pharmacists may provide in Canada. • The improvement in adverse events seen in this study may serve as a surrogate marker for improved time to treatment failure.
Limitations	What are the similarities and differences compared to other key papers?
• No control or comparison group • Did not describe how patients were selected (had over 2000 cases during study period, pharmacists saw ~ 500 of them) • Small number of patients who received ADR intervention by pharmacist (n=63) • Short study duration	• Similarities – retrospective, no comparator arm, descriptive statistics only. Bundled intervention. • Differences – diverse patient population, multiple pharmacists working across multiple clinical areas. Multiple treatments included. Impact demonstrated

• Outcome assessment was retrospective and most often completed using patient-reported data (risk of misclassification bias and missing data) • Most ADRs were not captured using a standardized scale (i.e., CTCAE v4.0) • Patient demographics are not available for all the patients seemingly included in the study. Characteristics are only available for the subset of patients whose pharmacist-recommended prescriptions were accepted by oncologist. • Possibly limited generalizability ○ Single-centre study in 1 hospital ○ Japan health care system	with short study duration. Focus on solid tumour malignancies.
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8. Article: Dürr P, Schlichtig K, Kelz C, Deutsch, B., Maas, R., Eckart, M., Wilke, J., Wagner, H., Wolff, K., Preub, C., Bruckl, V., Meidenbaur, N., Staerk, C., Mayr, A., Fietkau, R., Goebell, P., Kunath, F., Beckmann, M., Mackensen, A., Neurath, M., Pavel, M., Dorje, F., Fromm, M. The Randomized AMBORA Trial: Impact of Pharmacological/Pharmaceutical Care on Medication Safety and Patient-Reported Outcomes During Treatment With New Oral Anticancer Agents. J Clin Oncol 2021;39(18): 1983-1994.⁵⁵

Prepared by: Tom McFarlane (second review by Lauren Hutton)

A. Study objective	B. Intervention	C. Main results
To assess the impact of intensified clinical pharmacological/pharmaceutical care on patient safety and patient treatment perception during treatment with a broad range of new oral antitumor drugs.	Intervention arm: - Intensified pharmaceutical care program added to standard care (medication reconciliation, patient interview/assessment, providing and reviewing standardized written patient info material) - Patients were given structured patient counseling sessions in weeks 0, 1, 4, and 12 according to the recommended standards for orally administered antineoplastic agents published by ASCO. - The structured patient counseling sessions focused on the following four topics: (1) medication management, (2) counseling and training, (3) side effect prevention and management, and (4) adherence counseling	- Co-primary endpoint #1: Oncologic DRPs per patient were reduced in intervention arm vs control arm (3.85 vs 5.81, $p > 0.001$) over the 12-week period. - Co-primary endpoint #2: Patient satisfaction scores via validated questionnaire were higher in the intervention arm vs control (91.6 vs 74.4, $p < 0.001$) - The hazard ratio for the combined secondary end point of severe side effects (Common Terminology Criteria for Adverse Events ≥ 3), treatment discontinuation, unscheduled hospital admission, and death was 0.48 (95% CI, 0.32 to 0.71, $P < .001$) in favor of the intervention group

		Comparator arm: contact with clinical pharmacist at weeks 0, 4, and 12. Standard medical care as per disease specific routine practices at the institutions. Interventions or recommendations related to DRPs were done in control group if patient at risk of serious harm (“ethical reasons”).	
D. Design	E. Patient population	F. Data analysis	G. Authors’ conclusions
- Prospective, 1:1 randomized trial (randomization individualized by drug) - Multi-centre - N = 202 ambulatory cancer patients - Setting: Outpatient oncology department of 11 ambulatory clinics - Location: Germany - Study duration: 12 weeks - Accepted: February 12, 2021	Participants: - N = 202 ambulatory cancer patients - Intervention group: 98 patients - Control group: 104 patients - Inclusion criteria: 18 years of age or older - Diagnosed with any type of cancer. - On at least one newly prescribed oral agent - At least 16-week life expectancy - Exclusion criteria: - Patients not meeting the above criteria.	- Number of drug related problems assessed by negative binomial regression model (co-primary endpoint) and patient satisfaction assessed via validated TSQM (Ver II) questionnaire and analyzed via longitudinal mixed-effect regression model (co-primary endpoint) - Secondary endpoints included number of side effects; number of severe side effects rate of side effects; combined end point of severe side effects (CTCAE $\geq$ 3), treatment discontinuation, unscheduled hospitalization, and death; number of drug-related problems with reference to the complete medication; patient	“Treatment with oral anticancer drugs is associated with a broad range of medication errors and side effects. An intensified clinical pharmacological/pharmaceutical care has considerable, positive effects on the number of medication errors, patient treatment perception, and severe side effects.”

		treatment perception with their oral anticancer therapy; patient knowledge about their medication; health-related quality of life; and patient adherence; analyzed via logistic regression and Cox-proportional hazard models	
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Strengths	APPLICATION/SYNTHESIS: How does this study inform the AOcpKPI selection process (methods, AOcpKPI selection criteria, and candidate AOcpKPI)?
• Randomized, controlled, multi-centre trial. • Sound statistical methodology with an attempt to account for confounders using multiple logistic regression and Cox proportional hazard ratios. • Validated scales used to determine endpoints. • Clear description of how oncologic DRPs were defined • Published in high-impact journal	• Provides support for intensive patient education and follow-up as a potential critical activity for consideration of the AOcpKPI panel.
Limitations	What are the similarities and differences compared to other key papers?
• Medium sample size (n = 202 patients) • Blinding of patients and physicians not possible (open label) • Average observation time per patient was longer in intervention group; may lead to underestimation of effect size. • Some endpoints of interest were secondary, exploratory endpoints. • Differences between anti-tumour agents could not be ascertained because of small sample sizes.	Similarities – one of several examples found where patient teaching, education, and follow-up improved outcomes, bundled intervention. Differences – methodologic rigour (RCT, multi centre study, statistical significance of impact

Some patients in control arm required direct intervention due to DRPs for ethical reasons which may have been a confounder.	evaluated (inferential stats)). Evaluated prevention/proactive avoidance of DRPs. Evaluated level 1 AHRQ outcomes of morbidity, mortality as well as level 2 outcomes of treatment discontinuation and rates of severe toxicities.
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9. Article: Effect of Continuous Pharmacist Interventions on Pain Control and Side Effect Management in Outpatients with Cancer Receiving Opioid Treatments. Yamada, M., Matsumura, C., Jimaru, Y., Ueno, R., Takahashi, K., Yano, Y. Biol Pharm Bull 2018;41(6) :858-863⁴⁹

Prepared by: Tom McFarlane (secondary review by Lauren Hutton)	
A. Study objective	B. Intervention
To evaluate the effect of continuous interventions for pain management and opioid-induced side effects in outpatients with cancer	- Comprehensive pain education provided to patients with cancer pain. - Telephone interviews and counseling were provided to patients at home between 3 and 7 d after the first visit. - Interviews and assessment were repeated with every visit to physician. - Pharmacists taught the following items to the patients: how to assess pain intensity and pain response to analgesics, how to treat breakthrough pain using rescue doses, and how to prevent or treat side effects caused by analgesics. - Pain patterns and intensity, use and efficacy of rescue doses, types and degrees of adverse effects were assessed by pharmacists at each session and recommendations made to physicians.
C. Main results	
- Pain scores for the worst pain, average pain and least pain that patients experienced were statistically improved over the baseline at the second, third, and fourth visits. - Statistical comparison for nausea occurred only between visits 1 and 3 and showed that nausea was improved (p=0.03) - Amount of morphine equivalent increased over time (p=0.01)	
D. Design	E. Patient population
F. Data analysis	G. Authors' conclusions

• Single-arm, single centre, prospective observational study, retrospective analysis • N = 27 ambulatory cancer patients • Setting: Outpatient oncology clinic at Osaka-fu Saiseikai Noe Hospital • Location: Osaka, Japan • Study Period: October 2014 to March 2016 • Submitted: September 19, 2017 • Accepted: March 18, 2018	Participants: • N = 27 ambulatory cancer patients ○ Total of 105 interviews were conducted. • Inclusion criteria: ○ Ambulatory adult cancer patients with cancer pain who received pharmacist interventions from October 2014 to March 2016 • Exclusion criteria: ○ Patients who did not provide informed consent	• Pain intensity assessed using Numerical Rating Scale (NRS) • Adverse effects assessed using the Support Team Assessment Schedule Japanese edition (STAS-J) • Timing of pharmacist interviews using a term “occasion”; occasion 1 (before intervention), 2 (telephone interview), 3 (second visit), 4 (third visit), 5 (fourth visit) and 6 (fifth visit) • Pain changes were categorized as follows: better (pain score was reduced by 2 points or 30%), stable (pain score changed from -1 to +1), and worse (pain score increased by 2 points or more). The relationship between the pain score and pain score change (better, stable, or worse) was examined using Fisher’s exact test ($p < 0.05$). The grading scores of nausea and constipation, and morphine equivalent daily dose were compared among the occasions by Friedman’s test	• “In this study, we showed that pain and side effect management could be appropriately achieved by pharmacist interventions through continuous interviews and assessments of patients with cancer before consultations with physicians, thus highlighting the importance of pharmacist interventions.”
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Strengths	APPLICATION/SYNTHESIS: How does this study inform the AOcpKPI selection process (methods, AOcpKPI selection criteria, and candidate AOcpKPI)?
- Validated scales used to determine endpoints. - Appropriate statistical design - Clear description pain increases, decreases, and stability were defined. - Other adverse effects were examined in addition to pain. - Pain would be considered, by AOcpKPI working group as a surrogate of QoL – level 2 AHRQ outcome (as QoL was not specifically assessed using QoL assessment tools)	Provides support for intensive patient education and follow-up of pain regimens as a potential critical activity for consideration of the AOcpKPI panel.
Limitations	What are the similarities and differences compared to other key papers?
- Small sample size (n = 27 patients) - Prospective observational study - Lack of control group - Somewhat limited range of cancer types - Some endpoints of interest were secondary, exploratory endpoints. - Patient global QoL was not assessed.	Similarities: - During literature search, there were several examples found where patient teaching, education, and follow-up improved outcomes. - Most other studies were single centre with small populations, observational cohort design Differences: - This paper specifically looked at pain as an outcome; many other studies did not. - Inferential statistics reported (not descriptive stats alone)

	• Pharmacist interventions continued longitudinally until hospitalization or discharge from pain clinic (different vs finite care interventions of # weeks or cycles).
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10. Article: Quinn CS, Bergsbaken JJ, Blessinger EJ, Piccolo JK. Implementation of a clinical pharmacist-led service to optimize management of refractory chemotherapy-induced nausea and vomiting in adult hematology/oncology clinic. J Oncol Pharm Pract. 2022 Oct;28(7):1499-1507.⁴²

Prepared by: Mike Leblanc (secondary review by Lauren Hutton)

A. Study objective	B. Intervention	C. Main results
Extrapolated practice question: - Does pharmacist-led management of refractory CINV in hematology and oncology clinics reduce nausea and/or vomiting in patients with refractory CINV? Study objective: - To investigate the impact of “a pharmacist-led program for the management of refractory CINV in hematology and oncology clinics within an academic medical center.”	Intervention: - ambulatory oncology pharmacists who are embedded in multiple clinics and are intimately involved in the optimization of CINV prevention and treatment in the clinic setting. - Pharmacists were involved via pharmacist clinic visits, consult from a triage nurse, or nurses seeing patients in the chemotherapy infusion center. - Pharmacists worked in collaboration with primary providers and made interventions via verbal orders as needed. - Upon referral, pharmacist: - Conducted a baseline assessment. - Assessed adherence - Graded patient’s CINV - Optimized antiemetics as per institutional guideline	46 patients enrolled. 41 pts (89.1%) had an overall reduction in their nausea and vomiting from baseline. - Table 2 reviews impact of pharmacist intervention 11 pts (23.9%) met criteria for nonadherence to prescribed antiemetics at baseline - all patients were deemed adherent at unenrollment. - A total of 111 pharmacist interventions were made. - The most common intervention was addition of new breakthrough antiemetic. - The average number of interventions made per patient was 2.5. - On average, patients were enrolled in the program for 16.6 days and met with a pharmacist three times.

		○ Assisted with other medication-related issues such as drug interaction assessment and adverse event education as needed. Control: • No control. Retrospective chart audit	
D. Design	E. Patient population	F. Targeted outcomes and endpoints	G. Authors' conclusions
• Retrospective • Chart review • Descriptive • Single centre • N = 46 patients • Location: 1 hospital, US • Duration: February 2019 and January 2020	Inclusion: • All patients with refractory CINV were eligible for referral. • Diagnosis of refractory CINV was made by referring provider. Exclusion: • Patients on active study (clinical trial) were excluded. Baseline characteristics:	Primary outcome: • Proportion of patients whose CINV was improved through pharmacist intervention. • Nausea and vomiting grades at baseline were compared to grades at unenrollment. Secondary outcome: • Additional outcomes assessed included antiemetic adherence, and duration of program enrollment. • Number and categorization of pharmacist interventions Statistical analysis:	• “Patient enrollment in the program resulted in a measurable reduction in nausea and/or vomiting for patients with refractory CINV. The implemented consult model allowed for sustained pharmacist participation, while also identifying patients at high risk for refractory CINV who may benefit from proactive enrollment in a pharmacist-led program in the future.”

	Table 1 includes all important criteria.	Used descriptive statistics	
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Strengths	APPLICATION/SYNTHESIS: How does this study inform the AOcpKPI selection process (methods, AOcpKPI selection criteria, and candidate AOcpKPI)?
- Institutional guidelines for management of refractory CINV - Diagnosis of refractory CINV made by referring provider. - Real world generalizability - Measured impact on adherence as secondary outcome (adherence considered, by AOcpKPI working group, as AHRQ level 2 surrogate outcome – in case of CINV – surrogate to QoL and morbidity)	- Descriptive study outlining direct impact of a pharmacist intervention on patient outcome (CINV) - Intervention is generalizable as most centres have pharmacists providing CINV management as a core service. - Highlights need for collaboration but specific enough to the pharmacists’ activity and its influence on patient outcomes.
Limitations	What are the patterns (similarities and differences) compared to other key papers?
- Descriptive study, no control arm - Small sample size - Adherence only assessed as YES/NO - No insight on reasons for non-adherence - Cycle of treatment and time to diagnosis of refractory CINV unknown and unable to characterize or predict.	Similarities - Confirmed data from Oliveira and Maleki studies showing improved adherence by pharmacist intervention. - Consistent with Caracuel study on CINV and antiemetic medication “compliance”

	• Retrospective review, no comparator arm, descriptive statistics Differences: • Unique referral-based pharmacist-led program for finite period of time where pharmacists then unenrolled patients once target treatment outcomes (grade 1 or less CINV) were achieved.
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11. Article - Fujii, H., Ueda, Y., Hirose, C., Ohata, K., Sekiya, K., Kitahora, M., Sadaka, S., Yamamoto, S., Watanabe, D., Hayashi, H., Lihara, H., Kobayashi, R., Kaburaki, M., Matsuhashi, N., Takahashi, T., Makiyama, A., Yoshida, K., Hayashi, H., Suzuki, A. Pharmaceutical intervention for adverse events improves quality of life in patients with cancer undergoing outpatient chemotherapy(2022)²⁶

Prepared by: Lauren Hutton (secondary review by Tom McFarlane)

A. Study objective	B. Intervention	C. Main results
investigate whether pharmaceutical intervention provided by pharmacists in collaboration with physicians improved QOL in outpatient cancer chemotherapy	Pharmacists, as part of interdisciplinary outpatient chemotherapy team, assessed adverse events, such as nausea and vomiting, diarrhea, oral mucositis, dysgeusia, peripheral neuropathy, pain, malaise, alopecia, and skin disorders. Severity of AEs was graded using CTCAE version 5. - Patients received a daily checklist to monitor AEs between cycles of chemotherapy. - Pharmacists reviewed daily checklists and interviewed the patients. - Information collected and reviewed by pharmacist informed collaborative pharmacist-physician recording of AEs in electronic medical records. - Pharmacist-physician collaboration to provide	• N = 210 interventions (across 151 unique patients) • The most common type of cancer was breast cancer (27.8%), followed by colorectal (26.5%), pancreatic (13.2%), gastric (11.3%) (presenting only 10% or above for this table) • The most common type of regimen was oxaliplatin-based chemotherapy (21.2%), followed by paclitaxel/nanoparticle albumin-bound paclitaxel-based chemotherapy (17.9%), anthracyclines + cyclophosphamide (11.3%) (presenting only 10% or above for this table) • The adverse event with the most interventions was nausea and vomiting (33.1%; 50/210), followed by peripheral neuropathy (23.8%; 36/210), skin disorder (20.5%; 31/210), pain (19.2%; 29/210), and oral mucositis (16.6%; 25/210) • EQ-5D-5L (QoL measure) utility values significantly improved (0.8197 pre to 0.8603 post; P < 0.01) after pharmaceutical intervention for adverse events. A significant change in the proportion of patients with level 2 or higher scores pre- and post-intervention was observed only in the ‘mobility’ dimension (37.1% pre to 30.5% post; P = 0.014).

		pharmaceutical intervention based on clinical practice guidelines to treat moderate to severe AEs. - All patients at this hospital also completed QoL questionnaire after each chemotherapy cycle. QoL assessments were also completed in face-to-face interviews by the pharmacist during each patient clinic visit. There was no comparator arm for this study.	• EQ-5D-5L utility values significantly improved from pre- to postintervention for nausea and vomiting (0.8145 pre to 0.8603 post; $P = 0.016$), peripheral neuropathy (0.7798 pre to 0.7988 post; $P = 0.032$), and pain (0.7625 pre to 0.8197 post; $P = 0.035$).
D. Design	E. Patient Population	F. Targeted outcomes and endpoints	G. Authors' conclusions
• Retrospective observational study • Gifu university hospital in Japan • N = 210 case interventions (334 case interventions)	• Patients who underwent outpatient cancer chemotherapy between September 2017 and July 2020 were enrolled. • Included: patients who underwent pharmaceutical intervention by pharmacists in collaboration with physicians for adverse events	• Descriptive statistics on the cancer related characteristics (types of cancer and anticancer therapies) of patients experiencing grade 2 or higher AEs (as per CTCAE). • Change in AE CTCAE grade score pre- and post- pharmaceutical intervention (monitored by pharmacist and collaboratively managed by pharmacist-physician team) • Change in EQ-5D-5L QoL score pre and post pharmaceutical intervention (monitored by pharmacist and collaboratively managed by pharmacist-physician team)	• “Results indicate that pharmaceutical intervention provided by pharmacist in collaboration with physicians for adverse events is useful for improving QOL in cancer chemotherapy.” • “This study suggests that the enhancement of supportive care for adverse events, such as nausea and vomiting, peripheral neuropathy, and pain, may improve the QOL of outpatients undergoing chemotherapy. Pharmaceutical intervention provided by pharmacists in collaboration with physicians is useful in maintaining and improving QOL and in the management of adverse events during cancer treatment.”

potentially eligible from completing QoL questionnaire) • “Pre” intervention = the first clinic visit where a grade 2 or higher AE was identified • “post” intervention = the first clinic visit following the pharmaceutical intervention (i.e., the immediately next clinic visit after the “pre” intervention)	• Excluded: patients with missing or complete pre- or post-intervention QoL assessment; patients whose anticancer drugs were reduced by a physician		
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n assessment – i.e., one cycle length)			
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Strengths	APPLICATION/SYNTHESIS: How does this study inform the AOcpKPI selection process (methods, AOcpKPI selection criteria, and candidate AOcpKPI)?
• Measuring level 1 AHRQ outcome of QoL as associated with change in adverse event severity (only study looking at this link) • Study site routinely collected data on QoL and AEs and entered into EMR – low rate of exclusion for missing data. • Collaborative pharmacist-physician practice model reflective of many Canadian practice models • Used a validated Japanese language version of QoL tool	• Directly links pharmacist role (in a collaborative practice model) in monitoring and managing AEs to improved QoL for patients (with the most significant improvement noted in the QoL category of mobility) • Not a bundled intervention
Limitations	What are the patterns (similarities and differences) compared to other key papers?
• Generalizability – single centre study in Japan • Small sample sizes for individual adverse event categories may mean underpowered to detect a stat sig difference (? potential type 2 error). • Only included parenteral systemic anticancer therapy – limited generalizability to oral or take-home cancer drugs.	Similarities: • Small sample size, single centre study, limited generalizability • Describing core function of pharmacist (toxicity monitoring and management) and demonstrating positive impact Differences: • Unique difference compared to other literature – single critical activity topic intervention (adverse

	effect monitoring and management – specific to pharmaceutical intervention – did use interprofessional communication to co-manage ADR issues). • Focus of article seems to be on pharmaceutical intervention (i.e., medication) impact. Would consider this still relevant as it is the pharmacist, working in collaboration with physician, doing the monitoring of adverse effects and management of adverse effect with pharmaceutical strategies. • Evaluating QoL level 1 AHRQ patient outcome – only study evaluating this as core outcome
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12. Article: Zhao, X., Xu, R., Wang, Y., Zhu, W., Hu, H., Shen, Z., Guo, C., Zhang, J. Impacts of Pharmacists-Managed Oncology Outpatient Clinic on Resolving Drug-Related Problems in Ambulatory Neoplasm Patients: A Prospective Study in China. Year:2021. Journal: Inquiry: a journal of medical care organization, provision and financing. Vol: 58. Pages: 1-8 ⁵¹		Prepared by: Scott Edwards (secondary review by Lauren Hutton)	
A. Study objective		B. Intervention	C. Main results
Study objective: “To describe those DRPs identified and addressed by pharmacists and evaluated the impact of pharmacist interventions on the management of adverse reactions in ambulatory neoplasm patients”		Intervention: The main medication therapy management process in this study included the following 5 steps: (1) comprehensive medication therapy review (MTR). After patient’s visit, clinical diseases and medications information of patients, adverse reactions and laboratory tests would be collected and retrieved; (2) identifying drug-related problems (DRPs), to evaluate the indication, efficacy, safety and compliance of patients’ medications [with the 8-item medication adherence scale (Chinese version) (3) developing an intervention plan, and providing treatment advice based on the DRPs identified; (4) making personal medication record (PMR), recording a comprehensive list of patients’ medications; and (5) follow-up Comparator: No comparator arm	• A total of 316 DRPs (1.47 per patient) were identified. • The most common DRPs related to adverse reactions (42.1%) followed by non-adherence (16.1%), untreated indication (11.7%), and drug interactions (8.2%). • Of these DRPs, 261 (82.6%) had been confirmed as resolved after pharmacist interventions and 2 to 3 course follow-ups. • Among these DRPs, 133 adverse reactions were diagnosed by pharmacists NCI-CTCAE v4.0. • 78.2% (n = 104) of adverse reactions were improved following pharmacist interventions of medication adjustment and use of supportive drugs
D. Design	E. Patient population	F. Data analysis	G. Authors’ conclusions

• Prospective • Descriptive • Single centre • N = 215 patients Location: a tertiary teaching hospital in Shanghai • June 6, 2018, to June 6, 2020 • Follow -up – 4 months.	Inclusion - patients with malignant tumors regardless of demographic, tumor type or stage, and treatment characteristics Exclusion - severe mental disorder or had a life expectancy of fewer than 3 months.	A descriptive analysis was conducted on patients' demographics, disease characteristics, ADRs and types of DRPs. Continuous data were expressed as mean with standard deviation. Categorical variables were expressed as the number and percentages. The DRPs were classified according to the DRP classification by the American Society of Health-System Pharmacists (ASHP) with slight modifications. In the MTM software, they classified DRPs into 9 categories including (a) drug without indication; (b) untreated indication; (c) no effect of drug treatment; (d) underdose; (e) adverse reactions; (f) overdose; (g) potential drug interactions; (h) non-adherence, and (i) other problems (such as drug use process, drug information request).	This is the first pharmacists-managed oncology outpatient clinic to describe the type of DRPs in outpatients and evaluate the effectiveness of pharmacist interventions in China. The most common DRPs were adverse reactions, non-adherence, untreated indication and drug interactions in our study. Pharmacist interventions were efficacious in resolving DRPs and improving adverse reactions in ambulatory neoplasm patients. We confirmed that pharmacists have an important role in ambulatory neoplasm patients care.
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Strengths	APPLICATION/SYNTHESIS: How does this study inform the AOcpKPI selection process (methods, AOcpKPI selection criteria, and candidate AOcpKPI)?
Meaningful outcomes using ASHP DRPs. Prospective. Very clear reporting of intervention by pharmacist supports ability to replicate professional practice model. Included multiple types of cancer and treatments. Well characterized baseline data of patients including comorbidities. Assessing adverse reactions – considered by AOcpKPI working group to be reflective of level 2 AHRQ surrogate outcome for QoL and potentially morbidity (but did not directly report on QoL or morbidity in this study).	Study focuses on advanced level oncology pharmacy services. Pharmacist intervention was as a bundle at the initiation of chemo, a practice followed by many centers. Study suggests an oncology pharmacy managed clinic was effective in identifying and resolving DRP's in ambulatory oncology patients.
Limitations	What are the similarities and differences compared to other key papers?

Generalizability

o Not multi-center, study done in 1 hospital

o Chinese health care system

- o Study uses Pharmacist Work System of MTM software, not sure how this would apply to other oncology pharmacists.

Cancer center specialized in sarcoma, osteosarcoma so 20% of patients on IFOS-MAP which may not be the same amount of use for this regimen in other cancer centers.

No control groups.

The number of patients was small.

Study was designed to detect DRPs but was not designed to address.

the clinical outcome of these interventions or its clinical significance

Similarities:

- Small sample size, single centre, no comparator arm. Descriptive statistics.
- Demonstrates impact of pharmacist intervention on reducing severity of adverse events (treatment, not prevention)

Differences:

- Dominance of patients with sarcoma and osteosarcoma (and associated treatments)
- Prospective study design
- Included pharmacist-designed software system to support data management, documentation, and tracking of metrics.

13. Article: Caracuel F, Baños Ú, Herrera MD, Ramírez G, Muñoz N. Influence of pharmaceutical care on the delayed emesis associated with chemotherapy. Int J Clin Pharm (2014) 36:287–290 ²⁰		Prepared by: Scott Edwards (secondary review by Lauren Hutton)	
A. Study objective		B. Intervention	C. Main results
Study objective: “To analyze the effects of pharmaceutical care on the incidence of delayed CINV in adult cancer outpatients.” “Analyze the effects on adherence with antiemetics.”		Divided in two consecutive phases. In the first phase (control group, CG) there was no intervention and in the second there was an intervention (intervention group, IG). Intervention - Pharmaceutical intervention consisted of: (a) revision of antiemetic regimen administered in hospital. (b) Design of a leaflet with recommendations to diminish NV (diet and others), antiemetic regimen to be followed, phone and email from the pharmacists’ office and internet addresses for consultation. (c) Interview/education with the patient on the initial day of the CT. Control - The CG, received usual care consisting. of information and medication provided by nurses	In the final analysis they studied 102 patients (69 in the first phase and 33 in the second one) CR in the acute phase was very similar in the CG and the IG (88.4 vs 78.8 %; ARR, 9.6 %; 95 % CI -4.7 to 27.0. p = 0.237). In the delayed phase, CR was 69.6 % (CG) and 84.8 % (IG) (ARR, 15.2 %; 95 % CI -3.2 to 29.7. p = 0.144). Analyzing only the absence of vomiting, the difference was greater (71.0 CG vs 97.0 % IG: ARR, 26.0 %; 95 % CI 10.5–37.8; p = 0.002). Regarding nausea, the situation was also favorable for subjects in the IG (61 % of nausea absence). The duration of nausea decreased from the CG (median = 1 day; Q1, Q3, 0, 3) to the IG (median = 0; Q1, Q3, 0, 2). Self-reported adherence increased from 59 % in CG to 76 % in IG (ARR 17 %; 95 % CI -5 to 34; p = 0.127).
D. Design	E. Patient Population	F. Data analysis	G. Authors’ conclusions

• Prospective • Longitudinal • Single centre • N = 102 patients Location: Spain hospital, Virgen Macarena University Hospital, Seville, Spain • Follow-up – 4 months.	Inclusion - adult patients attending the Oncology Day Unit of the Spanish hospital and starting a new IV chemotherapy regimen (regardless of the treatment line) Exclusion - patients following a treatment with minimal emetic. chemotherapy risk and those who were on a corticoid treatment.	For data collection, patients were required to have. signed the informed consent. On the first visit they were given a daily file sheet to record the NV they suffered during the following 5 days and the antiemetics they finally took. Age, main diagnosis, chemotherapeutic regimen, and antiemetic treatment were also registered, and the intervention performed and queries only in the IG. 100 patients with a level of significance of 5 and 80 % power to detect differences of 25 % in the incidence of vomiting were enrolled. To compensate the possibility of losing 30 % of the patients, 143 patients should be included (ratio 2:1).	Pharmaceutical care in adult outpatients who start a CT cycle decreases the incidence of vomiting in the delayed phase of emesis. The presence of the pharmacist at The Oncology Day Unit is a major contribution in detecting. medication-related errors, individualizing antiemetic treatment, clarifying patients' doubts and increasing adherence, an essential factor in decreasing CINV. incidence.
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Strengths	APPLICATION/SYNTHESIS: How does this study inform the AOcpKPI selection process (methods, AOcpKPI selection criteria, and candidate AOcpKPI)?
Meaningful outcomes that are used in many CINV studies- Complete response (CR) was defined as no vomiting and no rescue treatment and absence of vomiting. Vomiting was classified according to the degree of severity in the CTCAE v3.0, a standardized accepted measure of toxicity. Prospective observational cohort study with a comparator and intervention arm (pre-post design) Measured adherence to anti-emetics which is often forgotten. Intervention was practical and authentic to the services pharmacist's desire to provide. CINV and adherence would be considered, by AOcpKPI working group, level 2 AHRQ surrogate outcome (surrogate for morbidity and QoL)	Study focuses on a key supportive care duty for oncology pharmacists, CINV. Pharmacist intervention was education (written and verbal) at the initiation of chemo, a practice followed by many centers. Additionally, pharmacists provided take home antiemetic kit during education session. Study suggests oncology pharmacist intervention can improve CR to antiemetics and decrease incidence of vomiting in delayed phase. The intervention of a pharmacist improved medication adherence to antiemetics.
Limitations	What are the similarities and differences compared to other key papers?
Generalizability - o Not multi-centre, study done in 1 hospital - o Spanish health care system	Similarities: • Observational design, single centre study • Highlight's role of pharmacist intervention on improving treatment tolerability

Risk of self-reporting bias

- o Information about clinical pharmacy services provided by each hospital was obtained by self-reported survey
- o Study used self-reported estimation rather than a true independent measurement of frequency and quality of services

Antiemetic regimens used not the same as international CINV guidelines.

The number of patients was small.

Adherence was measured by self-reporting.

- Assessed impact of pharmacist intervention on medication adherence

Differences:

- Prospective, interventional study
- Control arm
- Focused on CINV (delayed)
- Inferential statistics with power calculation described.
- Focusing on prevention of delayed CINV
- Not a bundled intervention and no clear description of follow up in methods/intervention.
- Pharmacists provided antiemetic medication take home kit during education intervention
- Education was verbal, written, and included developing standardized prescribing protocol prior to study (highlighted role of pharmacist contributing to admin/process roles within oncology team).

14. Article: Al-Taie A, Izzetin FV, Sancar M, Koseoglu A. Impact of clinical pharmacy recommendations and patient counselling program among patients with diabetes and cancer in outpatient oncology setting. Eur J Cancer Care 2020;29:e13261. ¹⁷		Prepared by: Tom Mcfarlane (secondary review by Lauren Hutton)	
A. Study objective		B. Intervention	C. Main results
To assess the effective provision of clinical pharmacy services and pharmacist-led counselling program on improving patient-related outcomes among patients with diabetes and newly diagnosed with cancer during chemotherapy administration.		- Intensified pharmaceutical care program added to standard care. - Counselling services and clinical pharmacy led care for 20 minutes every 2 weeks. - Strategies for mitigating AEs, information on DM care for those with diabetes, adherence counselling and checks - Patients given personalized booklet with written information on treatment goals, complications, nutrition, and DM lifestyle management.	- Oncologic patients within the intervention group showed better glycemic control as measured by A1C (decrease from 6.8 to 6.0 in the intervention group, p=0.049 and increase in the control group from 6.6 to 7.5, p=0.036) - Medication adherence was improved in intervention arm (86% vs 52%, p=0.0049) - Diabetes self-care activities were improved statistically in the intervention arm (diet p=0.037, self-monitoring of BG p=0.027, foot care p=0.085) - QoL was found to show insignificant changes in both control and intervention groups of this study.
D. Design	E. Patient population	F. Data analysis	G. Authors' conclusions
- Prospective, 1:1 randomized trial - Single centre - N = 100 ambulatory cancer patients - Setting: Outpatient oncology department - Location: Turkey	Participants: - N = 100 ambulatory cancer patients - Intervention group: 50 patients - Control group: 50 patients - Inclusion criteria: - Registered oncology outpatients	- Data collected on blood glucose, LFTs, CBC, A1C, renal function, medication adherence using MMAS, identification of DRPs, patient QoL using SF-36 validated questionnaire, number, and type of DRPs identified. - Chi-Square Test or Fisher's Exact Test was performed on	"Patients with diabetes and cancer receiving chemotherapy experienced improved patient-related outcomes after clinical pharmacy intervention and counselling program compared to the normal care group."

• Study duration: 3 months • Submitted: December 13, 2018 • Accepted: April 16, 2020	○ Over 18 years old ○ New cancer diagnosis ○ Type 1 or 2 DM diagnosis • Exclusion criteria: ○ Metastatic cancer ○ Patients undergoing neoadjuvant chemotherapy. ○ Patients undergoing radiotherapy	categorical variables and reported as number (frequency). Mann-Whitney test was used to find differences between the normal care group and the intervention group and Wilcoxon test was performed on differences between the baseline or 1st reading and 2nd readings at the end of the study. Statistical significance was set at $p \leq 0.05$	
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Strengths	APPLICATION/SYNTHESIS: How does this study inform the AOcpKPI selection process (methods, AOcpKPI selection criteria, and candidate AOcpKPI)?
• Randomized, controlled trial. • Clear endpoints • Validated scales used to determine endpoints. • Appropriate statistical design • HgB A1C would be considered an AHRQ level 2 surrogate outcome for diabetes related morbidity. Additionally, evidence supports the link between improved diabetes care and improved cancer treatment outcomes (although this was not assessed in this study).	• Provides support for diabetes education and follow-up as a potential critical activity for consideration of the AOcpKPI panel.
Limitations	What are the similarities and differences compared to other key papers?

• Small sample size (n = 100 patients) • Blinding of patients and physicians not possible (open label) • Limited to new diagnoses receiving adjuvant treatment. • Short follow-up of 3 months • Only one patient had type 1 DM; thus, only really applicable to type 2 patients • Patient self-reported outcomes may be inaccurate. • Identification of DRPs included as an outcome but not included as part of the pharmacist intervention. Reason for collection of DRPs not clearly explained.	Similarities: • During literature search, there were several examples found where patient teaching, education, and follow-up improved outcomes. • Most other studies were also single centre with small populations. Differences: • This is the only paper that was found that looked at DM management specifically. • Prospective, RCT (methodologic rigour). Well described methods.
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Appendix B: Round 1 Delphi Verbatim Comments Table

#	AOcpKPI	Additional comments made by panelists
1	Proportion of patients who receive oncology pharmacist clinical order review (cancer associated medication orders were clinically reviewed by an oncology pharmacist)	1. It will be important for us to consider how the AOcpKPI will be able to be measured as many sites may not have a strong CPOE/EMR that can enable the data pull. If it is too difficult for a site to measure will AOcpKPI be incorporated into practice. I am just thinking of sites in Ontario which use OPIS. Very limited system. Is documentation done elsewhere? Can that data be pulled? 2. "Proportion of patients" doesn't accurately inform me if this AOcpKPI refers to the clinical pharmacist reviewing the FIRST cycle of a chemotherapy order for a patient, or ALL cycles of a chemotherapy order. Ideally rephrase to "Proportion of patients whose had at least one cycle reviewed by a CP" or "Proportion of orders that are reviewed by a CP" 3. Consider further specification of cancer associated medication order review (i.e., treatment vs supportive care) 4. Standardize and define criteria to determine who is an "oncology pharmacist" (ie. board certified vs trained on site) 5. Standard for all pharmacy practice sites, may not be reflective of patient-facing direct patient care 6. What is the definition of "oncology pharmacist"? In number IV (4), are you asking if it is attributable in BOTH reactive and proactive settings? If yes, then am I to disagree if it is only attributable to one of these? 7. Oncology pharmacist conducting clinical order review for cancer associated medication protocols/treatment plans (including review of relevant test/exam results)

2	Proportion of patients who receive education about their cancer associated medications by an oncology pharmacist	1. Clarity around what constitutes adequate or AOcpKPI eligible patient education is welcomed. Patient teaching may exist on the spectrum - it could be a quick counsel vs. an in-depth review of treatment & toxicity management strategies. What would be the minimal requirement to satisfy this AOcpKPI 2. This AOcpKPI is not specific enough as there are many centers that provide education, but the focus may differ. is the AOcpKPI focused on the supportive meds (e.g., antiemetics) because in many centers the oncology nurse already educated the patient on chemo side effects? is the AOcpKPI focused on ensuring pharmacist is involved in all 3 (if not more) major categories - i) all supporting meds for the anticancer treatment, ii) oral anticancer treatment, and iii) parenteral anticancer treatment? Suggest this AOcpKPI is worded more specifically to identify if achieving this KPI requires fulfilling all, or part of, (i), (ii) and (iii) 3. Limitation: Definition of providing education is very broad and may not clearly define what the focus and scope of education provided to patients 4. Important performance indicator would be beneficial to define "education" since it could vary significantly between sites requiring detailed notes making it less efficient to measure. A certification process for oncology pharmacists, standardizing what constitutes patient education would be a benefit. 5. The value of this KPI presumes adherence could be related to efficacy of treatment. This KPI and #12 overlap and I wonder if they would best be separated into education at the point of prescribing/ dispensing / initiation and
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		active follow-up for adherence which includes education as an intervention. 6. Is there any capacity to comparing patient outcomes when pharmacist-educated vs. educated by other HCP? 7. regarding definition of "oncology pharmacist". ... I have answered the previous question thinking of the role of a pharmacist in an oncology setting. But should I have been answering from the perspective of the role of a pharmacist with specialized oncology training instead of a "regular" pharmacist? 8. Education provided from center to center may differ depending on experience of pharmacist, time provided to educate patient, and resources available. 9. Oncology pharmacist providing education to patient(s) & caregiver with cancer. It is very general. Perhaps this is on purpose, but this gives more obscurity when measuring. The timing is not defined. Very general statement.
3	Proportion of patients for whom an oncology pharmacist has developed and initiated a pharmaceutical care plan related to a patient's cancer or cancer associated medications (inclusive of drug therapy problem resolution)	1. As documentation & process differ significantly across provinces/institutions, further direction is welcomed here to define what would be the minimum action/documentation required to satisfy this candidate AOcpKPI 2. In case I am sought out for an explanation: I believe the ability to formulate a whole care plan for any given ambulatory patient is available in only specialized clinical service areas and not feasible for most oncology services due to lack of manpower. Care plans can only be established for a select patient population, or for a select clinical problem. This AOcpKPI will be excellent as a goal to strive for in smaller community centers but may be hard to achieve in our current human resource conditions.

		3. May be difficult/more onerous to measure and track if no existing system or software in place 4. Need good definition of what constitutes a "care plan" 5. The feasibility and efficiency of measurement would be highly dependent upon the systems in use in the health care setting. 6. Again, not sure what the definition of "oncology pharmacist" is. Is this any pharmacist working in an oncology setting? What do you mean be "developed and initiated"? Do you mean "developed and implemented"? 7. Oncology pharmacist develops and initiates a pharmaceutical care plan related to the patient's cancer or cancer associated medications (inclusive of drug therapy problem resolution). Initial care plan can evolve with a shared practice. When trying to track number of care plans.
4	Proportion of patients for whom an oncology pharmacist recommends or initiates a dose adjustment (including a medication hold) of a patient's cancer associated medications	1. feasibility to measure is based on the current state of North York General Hospital's chemo pharmacy program 2. Impact of this intervention is difficult to measure since impact is theoretical (true outcome unknown if pharmacist did not intervene) 3. There are limitations, especially in the community setting. This works best under strict medical directives and is prescriber dependent (variability in how prescribers choose to dose adjust certain patients). Therefore, issues with generalizability. 4. May be difficult to measure 5. The feasibility and efficiency of measurement would be very dependent upon scope of practice, use of delegated authority, etc. to avoid the confounding factor of acceptance rates. 6. These should be "clinically appropriate" dose adjustments based on patient and

		disease specific factors instead of "the monograph says to reduce" without application of clinical judgment 7. Oncology pharmacist recommends/initiates a dose adjustment/hold of cancer associated medications. What about addition? e.g., something was forgotten. Will also see if supportive meds come up in further questions in this survey.
5	Proportion of patients who have received an oncology pharmacist drug interaction assessment (inclusive of interaction management initiation)	1. Note that drug-drug interaction management was included in the bracketed text of an earlier candidate AOcpKPI - it would be presumed that this interaction check-based AOcpKPI would have to be completed first to inform the prior proposed candidate AOcpKPI 2. Perhaps it might be better to specify if this is the anticancer medication, the supportive medications, or both. The feasibility to measure is based on the current state of North York General Hospital's chemo pharmacy program 3. Essential 4. Drug interaction screen infrequently documented so measurement may be difficult 5. I am wondering about the practicalities of separating the measurement of drug interaction review from clinical order review. 6. This is a skill that only pharmacists should be venturing to perform so I would expect high % 7. should I be distinguishing whether the D/I check was done by an "oncology pharmacist" vs a "regular pharmacist"? 8. Oncology pharmacist conducts a drug interaction assessment (drug-drug, drug-NHP, drug-food) and initiates management as needed

6	Proportion of patients who had one or more drug therapy problems identified and resolved by an oncology pharmacist	1. Will the data from AOcpKPI #6 also include data from #4 and #5? This may be redundant unless we pull data for specific interventions. 2. feasibility to measure is based on the current state of North York General Hospital's chemo pharmacy program. With resource restrictions, it will be very difficult to accurately quantify the impact of the pharmacist on this very general KPI. Pharmacists are often solving DTPs, yet not documenting because of lack of time. 3. Overlap with AOcpKPI #3. Need additional clarification on differences (AOcpKPI#6 intended to capture resolution of DTPs outside of comprehensive pharmaceutical care plan?) 4. Number #6 and Number #7 are essentially the same. 5. Efficiency and feasibility of measurement will be complex due to the need to 'resolve' the problem. The medical records system would play a significant role. 6. It is vague and can encompass a variety of actions. e.g., supportive care. Oncology pharmacist identifies and resolves drug therapy problem
7	Number(s) and type(s) of drug therapy problems identified and resolved by an oncology pharmacist	1. I think I would prefer number and type of intervention which would include DDI, dose change, dose delay etc. rather than a proportion. 2. feasibility to measure is based on the current state of North York General Hospital's chemo pharmacy program. With resource restrictions, it will be very difficult to accurately quantify the impact of the pharmacist on this very general KPI. Pharmacists are often solving DTPs, yet not documenting because of lack of time. 3. In my opinion, I think that AOcpKPI #6 and #7 as very similar (duplicate). I

		think AOcpKPI #7 would be easier and more efficient to measure than AOcpKPI #6. But AOcpKPI #6 is more transferable data between institutions as a quality indicator. 4. Unknown whether quantity of DTPs is related to better outcomes 5. Issue of 'valuing' DRPs is relevant and this KPI may require further specific wording. 6. I think this goes directly hand in hand with the previous AOcpKPI - knowing the "types" of usual interventions supports templated documentation which supports data collection/measurement 7. Oncology pharmacist identifies and resolves drug therapy problem. I believe this is the same AOcpKPI as the previous one?
8	Proportion of patients who receive monitoring for, and management of cancer associated medication adverse drug reactions or toxicities by an oncology pharmacist	1. too much overlap with nursing and may be challenged as duplication of work 2. pharmacist toxicity assessment and intervention may be reliant on a collaborative practice environment 3. I struggle to determine how would you measure the management of ADRs when the strategies used for this management would be highly variable. 4. Pharmacist's opportunity for providing this AOcpKPI may vary by practice-based setting (e.g., requires clinical presence) 5. I like the wording of this one. There was a AOcpKPI previous that may overlap with this one. We would benefit from seeing the full list of AOcpKPIs to contrast and compare wording.
9	Proportion of patients for whom an oncology pharmacist referred for or coordinated additional examinations/treatments related to a patient's cancer or cancer associated medication	1. In order for referrals to a pharmacist to occur, this practice would have to be part of the procedures of the cancer program. I have worked in institutions where this is part of the practice and institutions where this is not.

2. the # of pharmacists positioned to make such interventions may be too small at this time to be generalizable. A large pool of pharmacists will require training to comfortably assess these results, thus not too generalizable nor sensitive. But it is indeed very specific as a KPI
3. Practice location's pharmacist scope of practice may be a consideration of whether pharmacist can provide this intervention. consider different wording for treatment in this AOcpKPI as intention is to refer to non-medication related interventions
4. Unsure if evidence supports direct correlation of exams/lab tests requested and outcomes
5. This AOcpKPI#9 is difficult to comment on because referrals for additional exams/treatments would need to be ordered by the primary oncologist because this is considered outside an Ontario oncology pharmacist's scope (unless some sort of medical directive is in place). However, it is important to note that there is value in having a pharmacist being able to easily refer for additional tests because physicians can forget and may further delay the treatment process. For example, missing Echos/ECGs, missing DYPD tests, repeat lab work (because values were abnormal or, certain lab parameters were missed like Phosphate/LFTs), social work (due to financial or transportation issues for the patient), and dietitians (due to appetite/weight changes or issues consuming solid foods for the patient)
6. It is unclear to me why this is a separate KPI from monitoring. Is this a scope of practice issue?
7. additional exams or treatments. There could be overlap with monitoring and recommending other supportive care treatments. Would need an example of

		what treatments this AOcpKPI is referring to.
10	Proportion of patients for whom an oncology pharmacist has developed and initiated a pharmaceutical care plan related to a patient's non-cancer comorbidity	1. Particularly noteworthy when the comorbidity is associated with the malignancy or as a result of treatment (i.e., HTN, blood glucose control, thyroid management etc.) 2. the # of pharmacists positioned to make true pharmaceutical care plans (as compared to single event interventions) may be too small at this time to be generalizable. A large pool of pharmacists will require training to comfortably address such interventions 3. Limitations based on practice sites. For example, some sites engage the Diabetes education clinicians during cancer treatment, other sites the oncology clinician may intervene. 4. Although I feel patient-centered care that considers the patient and all of his/her co-morbidities is important, I'm not sure this would be practical or valuable to measure as it involves a number of care providers and is not specific to the oncology pharmacist's role. 5. May be difficult to discriminate between cancer and non-cancer related issues 6. I would suggest that given that this KPI is based on one trial, that it could be combined with supportive care. 7. When management of those non-cancer comorbidities can influence cancer-related outcomes (e.g., smoking cessation), I can see this being applicable. However, overall, I feel this goes beyond intended expertise/scope of specialized hem-oncology pharmacists 8. cancer care is a busy practice; new oncology learners sometimes put more focus on non-oncology care plan (e.g.

cholesterol management) due to comfort with that field. Would mean 2 groups of pharmacists covering that domain, and no pharmacist covering the oncology domain. If one pharmacist did this extensively.

11 Proportion of patients for whom an oncology pharmacist conducts or reviews an ambulatory medication reconciliation (inclusive of initiation of drug therapy problem management)

1. given the current wording, it is too challenging to provide the manpower to successfully provide medication reconciliation at every visit. To be a successful indicator, the population cannot be a general oncology one. Even a patient population merely on oral oncology drugs may not be small enough to enable a high yield of interventions for the # of medication reconciliations required. This population truly must be at the highest risk for ADEs to enable a patient% to be successfully captured relative to the manpower required. That is, the "proportion of patients successfully receiving a reconciliation" is not a sensitive indicator (# of interventions made would be better). Thus, I conclude it's not generalizable.
2. Ambulatory medication reconciliation would suggest evaluation of all of a patient's medications (including non-oncology), challenging for oncology pharmacist to fully reconcile and resolve discrepancies and DTPs outside of oncology care plan.
3. Essential, appreciate adding the term "reviewing" and maintaining medication reconciliation as a shared responsibility.
4. Only examined as part of a bundled intervention
5. By "reviews", I interpret that to mean a Med Rec conducted by a non-pharmacist (e.g., technician)?
6. Given the evidence for pharm techs, not sure this one is as useful for "oncology pharmacists"

		7. May also be performed by pharmacy technician in certain centers. But is important step in looking for drug-interactions with cancer care.
12	Proportion of patients for whom the oncology pharmacist initiated interprofessional communication to prevent or resolve a drug therapy problem	1. I am not sure if this is a widespread practice. Would the pharmacist not discuss with oncologist who will then put in referral 2. Need more clarity on what interprofessional communication means. Is wording intentionally broad to capture all forms of communication? What specific value does measure interprofessional communication add and would this be related to the type of interprofessional communication being used? 3. Terminology is a little confusing. 4. Difficult to measure and interpret 5. This KPI needs to consider scope of practice. 6. What about in jurisdictions where there is pharmacist prescribing? Would appropriate documentation of pharmacist intervention (after the fact) be considered "interprofessional communication"? 7. phcs need to be able to connect with other HCPs in order to implement certain elements of DRPs.
13	Proportion of patients for whom an oncology pharmacist educates about or monitors for cancer associated medication adherence (inclusive of management of identified issues)	1. In some Centers adherence is assessed by nursing due to limited resources. We will have to take that into account. In those Centers the results for this cpKPI would be poor. 2. difficult to gather this data; with the current manpower, it will be challenging to assess adherences for all patients. Need a screening mechanism established that does not require pharmacist manpower. Or identification of a high-risk population (i.e., multiple myeloma patients on 10 drugs on average? palliative patients on oral

		therapy?). Cannot rely on RN or MDs to identify nonadherent population. as such, a valuable indicator, but not very sensitive nor generalizable (i.e., tricky to staff pharmacists for this role) 3. Limitation: assess medication adherence can vary from formal process using scales/questionnaires, tracking medication dispense dates (for oral medications), and informal assessment 4. Seems like 2 different metrics (educates and monitors). Adherence may be considered surrogate outcome 5. Need to consider how these overlaps with KPI #2. 6. adherence assessment can vary from center to center
14	Proportion of patients who receive pharmaceutical care from an oncology pharmacist after an initial oncology pharmacy encounter (follow up)	1. Is this intended to consolidate the KPIs #3, 4,5 6, and 10? Seems like it is a very general, all-encompassing KPI... this would be ideal, but still needs to be accompanied by more specific KPIs that address the common clinical work pharmacists do that impacts more patients (i.e., KPI #1) 2. F/u visits are likely tied to DTP or care plan. May be a valuable indicator 3. Efficiency and feasibility of measurement dependent on health information system. 4. This one is too vague. What does it mean to receive pharmaceutical care? This means different things to different people and the scope could be minute or massive 5. Would be helpful to have as a AOcpKPI
15	Proportion of patients who receive a comprehensive direct patient care BUNDLE from an oncology pharmacist working in collaboration with the interprofessional health care team (NOTE: BUNDLE = explicit care elements of education (KPI 2), DTP (KPI 6), monitors and manages toxicity (KPI 8), interprofessional communication (KPI 12), follow up (KPI 14); explicit care elements to be discussed at live	1. The BUNDLE would be a valuable AOcpKPI but work is required on prioritizing the other AOcpKPI before we decide on what the BUNDLE will look like. 2. I think this AOcpKPI is not specific enough and may be impractical to measure. Furthermore, it may be

	meeting that are represented as a bundle in trials and may likely include other candidate AOcpKPI care element provided concurrently)	difficult to generalize to a variety of practice types. 3. Difficult to measure (similarly to inpatient KPI) but evidence supports value of each indicator individually 4. Feasibility and efficiency of measurement dependent on health information system. 5. Would be useful when trying to advocate for more FTEs or change in scope at a center.
16	If you have a candidate AOcpKPI that you would like to suggest to be considered for inclusion in this Delphi please mention this in the text entry box below. If not, you can leave this box blank and continue to submit the Delphi survey.	1. Do we want to add funding assessment. In Ontario, this does take a significant amount of time and requires the pharmacist to understand lines of treatment, landmark trial and be able to interpret pathology. 2. The crosswalk contained a separate KPI for supportive care. I think that if we are separating ADRs, we should separate supportive care or better define how they relate to one another. 3. I would just suggest providing a glossary to ensure we all are defining key terms (like oncology pharmacist) the same way.

Appendix C: Round 2 Delphi Verbatim Comments Table

#	AOcpKPI	Prevalent Comments
1	Proportion of patients who receive oncology pharmacist clinical order review (cancer associated medication orders were clinically reviewed by an oncology pharmacist)	1. It was mentioned "oncology pharmacist" In Ontario, there are many satellites who deliver cancer treatment that don't have true oncology pharmacists. would having the specialization be a requirement for good care? 2. I think this AOcpKPI is more likely captured in a proactive rather than reactive setting 3. Highly measurable and generalizable but not typically a sought-after activity for direct patient care 4. Clinical order review does not seem to represent a pharmacist seeing patients in an ambulatory center. So, would this be a centralized role in a setting with many clinics?
2	Proportion of patients who receive education about their cancer associated medications by an oncology pharmacist	1. this KPI is very general (maybe on purpose) as to what type of content is covered or when it is done. 2. Education provided by an oncology pharmacist has great impact on patient treatment. 3. There is cross over between this general education statement and the one that is specific to education in relation to adherence. The definitions should be more distinct. We may also need to acknowledge the shared care element of education.
3	Proportion of patients for whom an oncology pharmacist has developed and initiated a pharmaceutical care plan related to a patient's cancer	1. does this mean an initial care plan? 2. need a little more clarity on what resolution means - does resolution

	or cancer associated medications (inclusive of drug therapy problem resolution)	mean recommendations accepted and put into action vs recommendations and care plan were conveyed to health care team 3. Would require a clear and detailed description of "pharmaceutical care plan" in this setting to aid in generalizable and efficient measurement consistent in all the practice settings.
4	Proportion of patients for whom an oncology pharmacist recommends or initiates a dose adjustment (including a medication hold) of a patient's cancer associated medications	1. I find the wording of this AOcpKPI is challenging as it is asking for a proportion who receive a dose adjustment, but this isn't characterizing whether an intervention was appropriate/required. That would be difficult to measure, however, intervention for the sake of intervention isn't adding value unless the intervention is appropriate/indicated. I hope that makes sense. 2. again, in rural areas will this be performed by an oncology pharmacist. It should be but will it be feasible 3. May be more valuable in capturing pharmacist impact in a more primarily proactive delivery model. In a reactive delivery model, a smaller proportion of patients would likely require a pharmacist intervention since other HCP will have also assessed the patient for similar dose modification. 4. I feel this may be an even better indicator than DTP identified, or care plan developed because it not only indicates an identified issue, but also represents an action by the pharmacist 5. Generalizability limitations due to clinician/prescribers practice variability

6. With varying scope of practice and shared care models, acceptance rates and discussions vs documented recommendations will be relevant for measurement. Should likely include addition, deletion and changing of medications.

5 Proportion of patients who have received an oncology pharmacist drug interaction assessment (inclusive of interaction management initiation)

1. This is absolutely a pharmacist-only role, so essential to any AOcpKPI final list.
2. comprehensive drug interaction assessment would require systems in place to capture updated and accurate BPMHs (which may not be consistently in place)
3. This is a KPI that could be completed by pharmacy technicians as well. It also represents a critical step in all order review processes.
4. I think that we cannot review cancer mI don't believe a drug interaction assessment (#5) could be done without a medication reconciliation review (#11). These AOcpKPI could be linked? Just a thought.
5. Is clinical order review the assessment piece and this KPI deals with managing any drug interactions identified through clinical order review? Otherwise, it seems redundant.

6 Proportion of patients who had one or more drug therapy problems identified and resolved by an oncology pharmacist

1. very general can get a variety of responses
2. again, how do we include the work done by pharmacists in a satellite/rural areas
3. Easy to measure and relatable for all pharmacists
4. Noting that AOcpKPI #6 and #7 are essentially the same. I think #6 is more of a quality measure where #7 is more for workload measurement?

7	Number(s) and type(s) of drug therapy problems identified and resolved by an oncology pharmacist	1. this is a repeat KPI 2. The numbers may not be as relevant as the types 3. We need to define resolution. If the intervention is not accepted there is a type of resolution but not the outcome that was initially desired 4. Unsure if the type of each DTP is necessary or if one is more important than the other. Ex dose adjustment, drug interaction, initiating supportive care treatment ... 5. Evidence available is only for identifying and resolving DRPs and not specific to the number and type. Very difficult to value categories or types of DRPs. 6. Types of DTPs identified and resolved, includes drug interactions and dose changes, so there is some duplication here, but this is a very crucial KPI to capture.
8	Proportion of patients who receive monitoring for, and management of cancer associated medication adverse drug reactions or toxicities by an oncology pharmacist	1. general KPI so a variety of applications will be seen. 2. I think this is very important to capture; how will we interpret the impact of pharmacist performing this role versus another HCP? 3. in many Centers toxicity assessment is done by nursing and pharmacy is involved if anything needs to be adjusted with drugs. this may skew this AOcpKPI a little bit depending on the site. As well, an oncology pharmacist would be most adept as performing this responsibility. This would not apply to colleague pharmacists who are in satellites. 4. Would be challenging to generalize this measurement since it would be practice setting dependent due to overlap with other health care providers.

5. This is an important KPI for pharmacists, but scope of practice and shared care may make measurement more challenging.

9 Proportion of patients for whom an oncology pharmacist referred for or coordinated additional examinations/treatments related to a patient's cancer or cancer associated medication

1. may need examples
2. Not many practice settings will allow the oncology pharmacist to order examination/treatments. Perhaps, does this does not need to fall under interventions.
3. more difficult to measure as interpretation for "treatments or examinations".
4. Agreed this would require clarification. Adding additional bloodwork to existing lab values is a common occurrence. But this AOcpKPI may require further clarification to make it more generalizable.
5. Without additional details regarding 'additional examinations and treatments', I am unclear on how this is different from monitoring and management.
6. Not sure about the relevance of this KPI

10 Proportion of patients for whom an oncology pharmacist has developed and initiated a pharmaceutical care plan related to a patient's non-cancer comorbidity

1. Add "as relevant to their cancer care." Otherwise, there would be overlap with the community pharmacist on some of these items.
2. With the exception of smoking cessation, which could be considered cancer-related, I don't think Hem-Oncology pharmacists can take this on.
3. I am not sure how often this occurs with the current resource challenges.

		4. Great for measuring OP's impact on patient as a whole but less on patient's oncology journey. 5. This could be encompassed in the pharmaceutical care plan when applicable. Generalizability an issue due to the variability of practice settings and if this is feasible due to resources. 6. Comorbidities related to cancer treatment would be included in a general pharmaceutical care plan. 7. This is a very important KPI for oncology pharmacists, as Oncologists are quite reluctant to address this aspect of a cancer patient's care!
11	Proportion of patients for whom an oncology pharmacist conducts or reviews an ambulatory medication reconciliation (inclusive of initiation of drug therapy problem management)	1. I think Med Rec is a role for a pharmacy professional, but it is not specifically a pharmacist function. 2. do we include BPMH. 3. MR is a standard KPI that pharmacists understand but key should be on "review" rather than "compile". 4. Unsure how to assess for drug interactions without a medication reconciliation "review" from an oncology team member (pharmacy tech or other). Could be part of the drug interaction review (AOcpKPI #5). 5. We may need to clarify that this refers to reconciliation specifically and that the BPMH could be conducted by another health care provider.
12	Proportion of patients for whom the oncology pharmacist initiated interprofessional communication to prevent or resolve a drug therapy problem	1. "As required". 2. would we not include this within the AOcpKPI relating to interventions -> type of intervention or action taken 3. I think the wording is a bit unclear. One interpretation could be to

		capture whenever the pharmacist communicates with any other health care provider in the team including the oncologist. Another interpretation may be trying to capture the proportion of patients the oncology pharmacist initiated interprofessional communication to resolve a DTP outside of the oncology care team 4. difficult to measure, somewhat difficult to interpret 5. I think with would be a part of the #6-#7 AOcpKPI. To ensure the team members are aware of pharmacist intervention. May require further clarity. 6. I am unclear if this is merely a scope of practice issue - interprofessional communication to operationalize a solution outside the pharmacist's scope?
13	Proportion of patients for whom an oncology pharmacist educates about or monitors for cancer associated medication adherence (inclusive of management of identified issues)	1. same as toxicity assessment, in many sites' adherence is performed by nursing staff 2. particularly critical for oral therapy options 3. This is very resource dependent and practice specific. 4. Could this KPI be reframed to remove 'educates' as the only strategy? So, pharmacists monitor or are asked to assist with and 'manage' adherence?
14	Proportion of patients who receive pharmaceutical care from an oncology pharmacist after an initial oncology pharmacy encounter (follow up)	1. Not sure what this one meant. Is this a blank one? Need to define the acronym. 2. I strongly support including follow-up in any final list 3. again, in rural/satellite setting, potentially will be followed cycle 1 by a general pharmacist? 4. May be valuable AOcpKPI in trying to capture ongoing continuity of

		care for patients and pharmacist impact vs model where patient is only assessed by oncology pharmacist with the initiation of therapy. 5. This is closely related to AOcpKPI #3 since from what I understand, a pharmaceutical care plan includes a follow-up. This prompts adjustments and is ongoing during patient care. Does this need to be separate from #3 to measure workload?
15	Proportion of patients who receive a comprehensive direct patient care BUNDLE from an oncology pharmacist working in collaboration with the interprofessional health care team (NOTE: BUNDLE = explicit care elements of education (KPI 2), DTP (KPI 6), monitors and manages toxicity (KPI 8), interprofessional communication (KPI 12), follow up (KPI 14); explicit care elements to be discussed at live meeting that are represented as a bundle in trials and may likely include other candidate AOcpKPI care element provided concurrently)	1. Not sure of the concept bundle vs when to use singles. People may bundle constantly when it is not a bundle scenario. 2. This is ideal - how do we quantify the impact on outcomes when patients receive a care "bundle" versus fewer AOcpKPIs 3. I think a care bundle would be very adaptable to a satellite setting. It would be like a specialist giving instructions to primary care. 4. Known KPI concept for pharmacists but may be difficult to measure unless sites are using electronic documentation systems 5. Would be difficult to generalize and unsure if it would reflect the true workload involved. I am guessing it could very significantly be based on practice settings. 6. Bundling is consistent with the evidence and patient centered care. Perhaps we also need to measure the components separately.
16	If you have a candidate AOcpKPI that you would like to suggest to be considered for inclusion in this Delphi please mention this in the text entry box below. If not, you can leave this box blank and continue to submit the Delphi survey.	1. Also want to second suggestion for funding/medication access assessment as this can take significant pharmacist resources (though work is likely collaboration

with oncologist or drug access
navigators, if available)

Appendix D: Round 3 Delphi Verbatim Comments Table

#	AOcpKPI	Prevalent Comments
1	Proportion of patients who receive oncology pharmacist clinical order review (cancer associated medication orders were clinically reviewed by an oncology pharmacist)	none
2	Proportion of patients who receive education about their cancer associated medications by an oncology pharmacist	1. Proportion of patients and their care partner(s) who receive education about their cancer associated medications by an oncology pharmacist 2. Perhaps consider "hematology-oncology" wherever oncology pharmacist is used
3	Proportion of patients for whom an oncology pharmacist has developed and initiated a pharmaceutical care plan related to a patient's cancer or cancer associated medications (inclusive of drug therapy problem resolution)	1. I prefer cpKPI #17 - Noted overlap with AOcpKPI# 14 and #17 - I think adding "Cancer or cancer associated medications" is limiting, since all the patient's medications will be part of the review and monitoring since they may be "affected" by or interact with the cancer or cancer associated medications and require monitoring (i.e., blood glucose & BP) which happens frequently in clinic (i.e., recommend adjustments to blood pressure medications, supplements or glycemic control). That is why I prefer AOcpKPI#17 to this one. 2. We will need to provide a comprehensive description of what is considered a care plan for a patient --& gt; will reviewing the orders and documenting any interventions and monitoring plan be sufficient?

4	Proportion of patients for whom an oncology pharmacist recommends or initiates therapy modification (e.g., dose adjustment, medication hold, or medication change) of a patient's cancer associated medications.	1. Proportion of patients for whom an oncology pharmacist recommends or initiates therapy modification (e.g., dose adjustment, medication hold, or medication change) of a patients' cancer-associated medications. 2. the change to the wording post live-meeting is much improved 3. suggest adding "adjustment/hold/modification of cancer associated medications" 4. Would "proportion" be appropriate or number of interventions... we would definitely need a denominator to show impact, but I believe that both the number and proportion would be valuable metrics. Would this data be captured by specified intervention? We will need to decide on a list of key interventions.
5	Proportion of patients who have received an oncology pharmacist drug interaction assessment (inclusive of interaction management initiation)	1. I think it is sufficient to say, "inclusive of interaction management " (remove the word "initiation") 2. This is really part of Accreditation Canada standards... So, it is a must!
6	Proportion of patients who had one or more drug therapy problems identified and resolved by an oncology pharmacist	1. #6 is a good stand-alone item for when a new DTP creates itself in between regular scheduled monitoring. e.g., patient calls mid cycle and wants to start a new supplement that causes bleeding. TC 2. Concerned with overlap with DRP #7 - increase clinician workload documenting more than once. Not sure what is more valuable information - the number of patients who had an intervention (easier to measure) or the total number of

interventions (some patients may have more than one).

3. This overlaps with #3 to a significant degree, which may result in duplication. Looking at the definition of "pharmaceutical care", it encompasses drug therapy identification and resolution, so this may be redundant.
4. Would this AOcpKPI not be the outcome of AOcpKPI #4? Should we not combine #4 and #6 where we would be discussion in #4 the resolutions obtained to DTPs detected

7 Number(s) and type(s) of drug therapy problems identified and resolved by an oncology pharmacist

1. #7 seems tedious to measure; pharmacist would use #6 instead. Would get inconsistent use of #7
2. Concerned with overlap with AOcpKPI #6 - increase clinician workload documenting more than once. Not sure what is more valuable information - the number of patients who had an intervention or the total number of interventions (some patients may have more than one) or if both are valuable.
3. should be optional and complementary to #6, hard to measure accurately
4. I think that we should combine #4 and #7 --> as dose adjustment, dose held, etc. would be the outcome of a DTP

8 Proportion of patients who receive monitoring for and management of cancer associated medication adverse drug reactions or toxicities by an oncology pharmacist

1. number of follow-ups and monitoring a pharmacist does is helpful to measure.
2. This could be considered overlapping with AOcpKPI #14 and #17 (care plan should include toxicity monitoring and management). Would have to clearly define how the information captured here is different than what

		would be captured in the monitoring of the pharmaceutical care plan. 3. Do we mean adverse effect related both to the cancer and the cancer medications? If so, should this be amended to "adverse effects associated with cancer and its medication treatments" or something like that
9	Proportion of patients for whom an oncology pharmacist referred for or coordinated additional examinations/treatments related to a patient's cancer or cancer associated medication	1. Do not want to include this one b/c its data is captured elsewhere. 2. Significant overlap with, and would be better captured by AOcpKPI #14 or #17
10	Proportion of patients for whom an oncology pharmacist has addressed pharmaceutical care related to a patient's non-cancer comorbidity.	1. I like the revised wording "Proportion of patients for whom an oncology pharmacist has addressed pharmaceutical care related to a patient's non-cancer comorbidity" rather than the original wording. One pharmacist don't need to feel pressured to solve non-oncology issues (depending on the other pharmacy supports available for the pt in their practice). But this KPI is available if and when it does occur. 2. Significant overlap with and would be better captured by AOcpKPI #17 - would also be difficult to determine "non-cancer comorbidity" if the cancer treatment is in fact exacerbating the non-cancer comorbidity. Clinicians' documentation will likely be inconsistent. 3. If this had a caveat to it that included management of non-cancer morbidities that were affected/worsened by cancer-associated medications (e.g., HTN, glucose, thyroid, etc.), I could see this being a more relevant KPI. However, I think management of

		any impact of cancer Tx on pre-existing conditions would be captured by scope of other KPIs. - instead of "has addressed", should it be "has performed"? - This will be difficult depending on the province. In Ontario, due to information provided by CPSO, oncologists are not interfering with non-oncology treatment unless there will be impact from oncology treatment.
11	Proportion of patients for whom an oncology pharmacist reviews a comprehensive BPMH (may include conducting, reconciliation, inclusive of initiation of drug therapy problem management)	- The wording needs some tweaking but the key word to keep in the final version is that the pharmacy is REVIEWING the BPMH. the actual BPMH could be done by a tech, but the oncology pharmacy REVIEWS it. "Proportion of patients for whom an oncology pharmacist reviews a comprehensive BPMH (may include conducting, reconciliation, and could be inclusive of initiating drug therapy problem management). The last part "could be inclusive of DTP management could be omitted here as it would be captured in another KPI. - I prefer the wording of AOcpKPI #16 - better describes what occurs in clinic, language is clearer in my opinion - The wording inside the parenthesis is bulky. Using the term "may include" and then "inclusive of" in sounds redundant. I am not sure the "inclusive of initiation of drug therapy problem management" is necessary at all.
12	Proportion of patients for whom the oncology pharmacist initiated interprofessional communication to prevent or resolve a drug therapy problem	- Significant overlap with, and would be better captured by AOcpKPI #14 or #17 - like the new wording

3. In line with discussion at the meeting, I feel communication is paramount to professional responsibilities and is embedded in any possible resolution of DTPs, thus captured in the scope of other KPIs.
4. communication is difficult to measure, as it happens frequently with nurses, physicians, technicians, allied health. Not sure how to measure this accurately and efficiently
5. It will depend on organization to organization if a pharmacist can refer to another service

13 Proportion of patients for whom an oncology pharmacist educates about or monitors for cancer associated medication adherence (inclusive of management of identified issues)

1. Supporting patient understanding of the importance of adherence is a huge topic and depends so much on supporting and accommodating patient's needs. I think this KPI is still not quite clear as to the metric? The education - when? The assessment of adherence - when? The follow-up intervention needed in the event of suboptimal adherence. There may be too many items rolled into a single KPI.
2. The success of this AOcpKPI will depend on who is monitoring adherence in the organization. In many settings, it is the nurse who is responsible for this metric.

14 Proportion of patients who receive pharmaceutical care follow-up from an oncology pharmacist after an initial oncology pharmacy encounter.

1. I am no longer sure how this one is different than #8. I forget what was discussed at the live meeting.
2. Noted overlap with AOcpKPI#3 or 17 (17 preferred)- would be included as part of the care plan. However, the word "initiated" to AOcpKPI #17 makes justifies the value of AOcpKPI #14. One is the initiation and then follow-up is separate. Could be valuable

		information when the clinician doing the follow-up is not the same one who initiated the care plan. This would likely be part of a BUNDLE
15	Proportion of patients who receive a comprehensive direct patient care BUNDLE from an oncology pharmacist working in collaboration with the interprofessional health care team (NOTE: BUNDLE = explicit care elements of education (KPI 2), DTP (KPI 6), monitors and manages toxicity (KPI 8), interprofessional communication (KPI 12), follow up (KPI 14); explicit care elements to be discussed at live meeting that are represented as a bundle in trials and may likely include other candidate AOcpKPI care element provided concurrently)	1. Bundles will need a clear explanation of what is included so pharmacists know when to use them. 2. This will be easier to assess once the KPI's included are identified once chosen. A bundle would be valuable. 3. In any "bundle", I would prefer to see KPI 12 replaced by KPI 13 (adherence education, assessment, and support). I think KPI 12 is implied 4. I would prefer not to bundle everything so that the metrics are much more meaningful. But I agree that certain AOcpKPI should be bundled such as #4 and #7.
16	Proportion of patients for whom an oncology pharmacist conducts a comprehensive medication review (may include reconciliation, inclusive of initiation of drug therapy problem management)	1. Need to make the word CONDUCT in capitals for the final version. 2. Prefer the description of this AOcpKPI to AOcpKPI #11 3. prefer this wording to the KPI referencing BPMH 4. I prefer this statement over the BPMH version, as it broadens the impact pharmacists have overall 5. I think we need to tease out the different metrics within this AOcpKPI. The data relating to BPMH and medication reconciliation is mandated by Accreditation Canada. Perhaps in coming to the final list of AOcpKPIs we should take into account the Standards in Accreditation Canada and make sure that everything aligns

17	Proportion of oncology patients for whom an oncology pharmacist has developed and initiated a pharmaceutical care plan (inclusive of a patient's cancer and non-cancer comorbidities)	1. I prefer the wording of the KPI that presented earlier that discussed creating a pharmaceutical care plan 2. I prefer this one to AOcpKPI#3 - I don't think we can always/easily separate the pharmaceutical care plan to only include the cancer associated medications. Noted aligned with AOcpKPI #14 - a care plan includes follow-up. The addition of the word "initiated" to AOcpKPI #17 clarifies the difference between the two which could be bundled together. 3. I agree with this IF additional wording could note management of non-cancer related conditions is only a focus if the potential is there for cancer-associated medications to have potential impact/effect on management of non-cancer related conditions (which is much more common than 10-20 years ago). I realize that is complicated recommendation :-) 4. I prefer this broader KPI over the cancer-specific one to reflect the diversity of our profession's impact 5. we should choose either #3 or this one.....not both
18	OPTIONAL (non-mandatory) Overall end of survey comment section – Please note down any final comments for the research team to take into consideration if you have any	1. Thanks so much for the opportunity to discuss and contribute. 2. Thank you for the opportunity to participate in this project. 3. What a great project - I'm so honored to be included. Thank you for your extensive, important work that will continue to drive practice forward and create metrics that even funders will understand ;-)

Appendix E: Delphi Panelist Characteristics Table

Panelist	Geographic (Province)	Urban vs. Rural	Academic vs. Community	Gender	Official Language	Level of Experience (New vs. Experienced)	Primary Practice Role	Type of Oncology Practice Focus (Heme vs. Solid vs. Specific Tumour Site)	Adult vs Pediatric	Type of Oncology Practice Setting
1. Blueberry	BC	Urban	Academic	Male	English	Experienced (fellowship in CAPHO)	Clinical researcher/ administrator	Solid tumour	Adult	Outpatient
2. Blackberry	BC	Urban	Academic	Female	English	Experienced	Clinical program practice lead	Solid tumour	Adult	Inpatient/ outpatient
3. Orange	Manitoba	Urban	Academic	Female	English	Experienced	Front line	Solid tumour/ heme	Adult	Outpatient
4. Cherry	Ontario	Urban	Community	Male	English	Experienced	Front line	Solid tumour/ heme	Adult	Outpatient
5. Raspberry	Ontario	Urban	Community	Female	English	Experienced	Administrator/clin ical researcher/ front line	Solid tumour/ heme	Adult	Outpatient
6. Dragonfruit	Ontario	Urban	Academic	Female	English	Experienced	Front line	Heme	Adult	Outpatient
7. Guava	New Brunswick	Urban	Academic	Male	English/ French	Experienced	Administrator	Solid tumour/hem e	Adult	Outpatient
8. Peach	New Brunswick	Urban	Academic	Male	English	Experienced	Clinical researcher/front line	Solid tumour/hem e	Adult	Outpatient
9. Plum	Newfoundland	Urban	Academic	Male	English	Experienced	Front line	Solid tumour/hem e	Adult	Outpatient

10.Apple	Nova Scotia	Urban	Academic	Female	English	New	Pediatrics/front line	Heme	Pediatric	Inpatient/ outpatient
11.Pineapple	Nova Scotia	Rural	Community	Female	French	Experienced	Front line	Solid/heme	Adult	Outpatient
12.Pomegranate	BC	Rural	Community	Male	English	Experienced	Front line	Solid/heme	Adult	Outpatient
13.Apricot	Quebec	Urban	Academic	Male	French	Experienced	Front line	Solid/heme	Adult	Outpatient
14.Mango	Ontario	Urban	Community	Male	English	New	Systemic therapy pharmacist	Solid/heme	Adult	Outpatient
15.Kiwi	Ontario	Urban	Community	Female	English	Experienced	Front line	Solid/heme	Adult	Outpatient
16.Strawberry	Alberta	Urban	Community	Female	English	Experienced	Front line	Solid/heme	Adult	Outpatient
17. Banana	Ontario	Urban	Community	Female	English	New	Front line	Solid	Adult	Outpatient
18.Pear	Ontario	Urban	Community	Female	English	Experienced	Front line	Solid/heme	Adult	Outpatient

Appendix F: Relationship between research team, Delphi panelists, steering group and general population of ambulatory oncology pharmacists

The research team, consisting of seven members, played a pivotal role in facilitating the modified Delphi process for this study. This team was a subset of the larger steering group, with some members serving in both capacities. They were responsible for preparing pre-Delphi materials, conducting the live meeting, and creating templates for data analysis. Information about the research team members can be found in Appendix G and their role/responsibilities in Table 17 below.

To provide overarching guidance for the project, a steering group was established, initiated by co-chairs Tom McFarlane and Lauren Hutton. They sent out an informal email invitation to key opinion leaders (respected experts in ambulatory oncology pharmacy across Canada) inviting them to join the steering group. Among the core members were Olavo Fernandes, recognized for his work on determining clinical pharmacy key performance indicators (cpKPIs) in acute care pharmacy, and Bryanna Tibensky, who led the first phase of this project. The steering group comprised the author and 9 pharmacists, both new and experienced, with expertise in ambulatory oncology pharmacy practice, representing various provinces in Canada, including Alberta, British Columbia, Manitoba, New Brunswick, Newfoundland, Nova Scotia, and Ontario. Several members of the research team including: Rozhannaa Sothilingam, Tom McFarlane, Lauren Hutton and Olavo Fernandes were also part of this steering group. Details about the steering group members are listed in Appendix G and their role/responsibilities in Table 17 below.

The steering group's role was to use their expertise during the pre-Delphi stages, which included: reaching consensus on a 5-point definition of a AOcpKPI and consensus on 9 selection criteria. The Agency for Healthcare Research and Quality (AHRQ) level outcomes guideline is comprised of different types of evidence used to assess the effectiveness of healthcare practices and interventions.⁶³ AHRQ categorizes outcomes based on the strength and reliability of the evidence.⁶³ The steering group was also responsible for reviewing and critically appraising literature, and assigning Agency for Healthcare Research and Quality (AHRQ)-level outcomes to be included in evidence summary tables.

Table 17: Roles and Responsibilities Overview in the Modified Delphi Research Project

Type of Relationship	Role/Responsibility
Research Team (7 people)	- The research team was responsible for the coordination, management and facilitation of the overall study, including the design, execution and analysis of the modified Delphi process. - The research team led the research study whereas the steering group provided support to the research team in the modified Delphi process. The steering group includes some members of the research team (see appendix G below for details).

	- The research team developed the survey instrument used to gather ranking data for each candidate AOcpKPI including panelist opinions/comments during the Delphi rounds. - The research team supervised the consensus process by reviewing marginal AOcpKPIs during the live meeting and collaborated with panelists to adjust wording/add new AOcpKPIs. - The research team collected the responses from the participants, analyzed the data and synthesized the results after each round.
Steering Group (9 pharmacists + MSc student Rozhannaa Sothilingam)	- The steering group, composed of the author and experts in ambulatory oncology pharmacy, provided their expert insight/opinions in the ranking of the

	literature from the literature search by assigning AHRQ level outcomes. - The steering group contributed to the identification of the 5-point AOcpKPI definition and 9 selection criteria which was used to evaluate the candidate AOcpKPIs. -The steering group created the evidence-linked critical activity topics and arbitrary AOcpKPIs that measure them for inclusion in the Delphi.
Master (MSc) student (Rozhannaa Sothilingam)	-The author's primary responsibility as a member of the research team was to conduct, facilitate and analyze the results from steps 7-8 (conducted and finalized the results of the modified Delphi process).

-The role of the author also included:

- Step 4a, where a literature search was conducted alongside Tom McFarlane and Breanna Quan (Pharmacy Research Assistant).
- Step 4b, the author was involved in summarizing articles in the evidence summary tables.
- Step 5, the author drafted the survey instrument using Qualtrics (Qualtrics, 2023)¹⁴.
- Step 6b, the author distributed the education training package to panelists and prepared the study orientation presentation.

General population of ambulatory oncology pharmacists	- A national call via CAPHO (The Canadian Association of Pharmacy in Oncology) was sent out to the general population of ambulatory oncology pharmacists to ensure no candidate AOcpKPIs were overlooked in our literature search.
Delphi Panelists (18 pharmacists participated in Round 1, while 16 pharmacists continued in Round 2 and subsequent rounds)	- The panelists were practitioners in the field of ambulatory oncology pharmacy that provided their knowledge and expertise to suggest, evaluate and refine the candidate AOcpKPIs. - Throughout each of the 3 rounds and live meeting the panelists reviewed the candidate AOcpKPIs based on the 9 selection criteria, offered feedback and suggested modifications in the comment box for rounds 1 and 2 and

optional comments were left in round 3. In addition, the panelists provided an overall rating for each of the candidate AOcpKPIs. Their input was essential in refining the list of candidate AOcpKPIs.

- The panelists' collective judgment finalized the consensus AOcpKPIs that were most important for implementation in ambulatory oncology pharmacy.

Appendix G: Research Team and Steering Group Personnel

Members of the Research Team: (Note: Members of the research team also serve on the steering group, except for those designated as part of the research team only)

MSc Pharmacy Student

ROZHANNAA SOTHILINGAM

University of Waterloo School of Pharmacy
HBCS Chemistry and Biology, University of Waterloo

PharmD Research Assistant Student

BREANNA QUAN (Note: A part of the research team only)

PharmD (candidate), University of Waterloo School of Pharmacy

Supervisor

DR. TOM MCFARLANE

Associate Professor, Teaching Stream,
University of Waterloo School of Pharmacy
PharmD, Idaho State University
BScPhm, University of Toronto

Committee Members

DR. SHERILYN HOULE

(Note: A part of the research team only)

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University of Waterloo School of Pharmacy
PhD, University of Alberta
Post-Baccalaureate Certificate in Teaching and Learning in Higher
Education, University of Alberta
BSP, University of Saskatchewan

DR. OLAVO FERNANDES

Director of Pharmacy- Clinical & Operation at UHN
Assistant Professor (Status), University of Toronto
Adjunct Professor, University of Waterloo
BScPhm, University of Toronto
PharmD, University of Toronto

DR. LAUREN HUTTON

BScPhm, ACPR, PharmD, RPh
Adjunct Assistant Professor, University of Waterloo
Oncology Pharmacy Specialist, Extend Pharmacy

DR. JENNIFER LO

(Note: A part of the research team only)
Combined BScPhm & PharmD, University of Toronto
HBS Sc Toxicology, University of Toronto

Members of the Steering Group:

DR. SHIRIN ABADI

Pharmacy Clinical & Education Coordinator, BC Cancer
MBA, Beedie School of Business, Simon Fraser University
Graduate Certificate in Business, Simon Fraser University
PharmD, University of Toronto
BScPhm, ACPR, University of Toronto

DR. SCOTT EDWARDS

Clinical Pharmacy Specialist, Eastern Health. St. John's
Clinical Assistant Professor Oncology, Memorial University
Masters in Oncology, Newcastle University
PharmD, University of Washington
BScPHm, Memorial University
BSC Neuroscience, Memorial University

DR. MICHAEL LEBLANC

Director, Pharmacy Professional Practice at Horizon Health
Network
Clinical Oncology Pharmacist, Eastern Health
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BScPhm, Memorial University

DR. JASON WENTZELL

President, Canadian Association of Pharmacy in Oncology
Board Certified Oncology Pharmacist
Postgraduate Certification, Data Science & Business Analytics,
Texas McCombs School of Business
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Primary Care Pharmacist, Central Brampton Family Health Team
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DR. CARLO DeANGELIS

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