2015

Pediatric Oncology Nurses' Knowledge of Safe Administration of Chemotherapy/Biotherapy

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Final Practice Inquiry Project

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Summer 2015

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Dedication

I would like to dedicate this work to my husband, Jeff, who has been a constant motivator and shoulder to lean on throughout this entire process. I could not have finished “doctor-nurse” school without your love and support, and for this I thank you. I would also like to recognize my precious Anne Claire who inspires me daily to be the very best practitioner and mommy. Finally, I give thanks to my colleagues who have completed this journey with me, Angie Malone and Mary Skinner. I could not have completed this without your friendships and support—many thanks!

Acknowledgements

I would like to acknowledge and thank my clinical chair, Dr. Karen Stefaniak, for being a constant source of encouragement and wisdom. Thank you for believing in me as a doctoral student and for motivating me when I needed it! Thank you to my committee members, Dr. Leslie Scott and Dr. Sherry Bayliff for supporting me through the program. I would also like to recognize Dr. Amanda Wiggins for her suggestions and assistance with the statistical analysis of data. Finally, to my colleagues and staff nurses in KCH and the DanceBlue Pediatric Oncology clinic—none of this would have been possible without your cooperation, sincere thanks to you!

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Introduction to Practice Inquiry Project

The introduction of chemotherapy in pediatric oncology tremendously impacted the survival of children with cancer. In the past 60 years, the survival rates of children with cancer have drastically improved with 5-year survival rates of the most common types of childhood cancer nearing 90%. Use of chemotherapeutic agents is not without risk as they are administered in a variety of routes and doses. Disturbingly high error rate ranging from 4% to 18%, depending upon the administration setting (inpatient or outpatient) are reported in the literature (Watts & Parsons, 2013).

Chemotherapy errors have the potential to be lethal because of a low therapeutic index and the lack of an antidote to reverse potential toxicities associated with chemotherapy errors. Guidelines for safe administration of chemotherapy have been published by the Oncology Nursing Society and the American Society of Health-Systems Pharmacists; however, the Association of Pediatric Hematology and Oncology Nurses (APHON) recognized the need for tailored guidelines for the pediatric oncology patient population. In 2004, APHON introduced the Pediatric Chemotherapy and Biotherapy Provider Program with the goal of giving nurses the knowledge needed to safely and consistently administer chemotherapy and biotherapy. Since its inception, the APHON chemotherapy and biotherapy program has become the national standard for teaching nurses how to administer chemotherapy and biotherapy to children and adolescents (Kline, 2007).

The overall purpose of this practice inquiry project is to assess knowledge, beliefs and the impact nursing has had on chemotherapy/biotherapy administration one year post implementation of the APHON Chemotherapy/Biotherapy Provider Program in a children's hospital located within a large medical teaching facility. The first manuscript is a review of articles published between 2005 and 2015 regarding methods/procedures used to ensure safe

chemotherapy administration to oncology patients. The findings from this review provided evidence to support a planned change in chemotherapy administration curriculum for pediatric oncology nurses in a children's hospital. Strategies suggested for standardizing administration of chemotherapy included adoption of clinical guidelines or curriculum set forth by professional organizations including the American Society of Clinical Oncology (ASCO), the Oncology Nursing Society (ONS), as well as the Association of Pediatric Hematology and Oncology Nurses (APHON) (Jacobson, et al., 2009; Kline, 2007; Neuss, Polovich, McNiff, Esper, Gilmore, LeFebvre, Schulmeister, & Jacobson, 2013).

The second manuscript is a microsystem level analysis on the implementation of the APHON program and discusses the importance of following a change theory to successfully implement a planned change. It focuses on the importance of having a purposeful, collaborative plan as well as support on multiple system levels, and by-in from those affected by change in order to achieve successful plan implementation. Continuous process improvement in addition to provision of feedback related to performance and outcomes were also identified as factors influencing a planned change that endures.

The final manuscript describes an analysis performed to determine the knowledge base and beliefs of nurses regarding administration of chemotherapy/biotherapy to pediatric oncology patients one year post implementation of the APHON chemotherapy/biotherapy course. Additionally, the researcher was interested in the nurses' beliefs regarding the impact of nursing on safe administration of chemotherapy/biotherapy to pediatric oncology patients.

Safe Administration of Chemotherapy for the Pediatric Oncology Patient:

A Review of Literature

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Abstract

The advent and use of chemotherapy tremendously impacted the survival of children with cancer. In the past 60 years, the survival rates of children with cancer have drastically improved with 5-year survival rates of the most common types of childhood cancer nearing 90%. Use of chemotherapeutic agents is not without risk as they are administered in a variety of routes and doses. It is important for nurses to have the knowledge needed to safely administer antineoplastic agents to all patients, but in particular pediatric oncology patients. The goal of this article is to review the policies and practices used in facilities across the country to ensure chemotherapy and biotherapy are administered safely at all times.

Keywords: safe chemotherapy administration, guidelines, practices, oncology, pediatric oncology, nursing competence

Safe Administration of Chemotherapy for the Pediatric Oncology Patient:

A Review of Literature

Childhood cancer will affect 1 in every 285 children in the United States before they turn 20 years old and accounts for more disease related deaths in children than AIDS, asthma, cystic fibrosis, diabetes and congenital anomalies combined. Fortunately, medical advances over the last sixty years have improved survival rates and nearly 90% of children with the most common types of cancer will have at least a 5-year event-free survival (St. Baldrick's Foundation, 2014). The use of antineoplastic chemotherapy agents in particular, has tremendously improved survival rates for children with childhood cancer; however, they are not used without risk and they top the list of high-alert medications according to the Institute for Safe Medication Practices (2003). Because of their low therapeutic index and narrow safety margins, chemotherapy agents have the potential to cause catastrophic harm if administration error occurred. Studies in pediatric oncology suggest a disturbingly high error rate ranging from 4% to 18%, depending upon the administration setting (inpatient or outpatient) (Watts & Parsons, 2013).

Complex treatment protocols including multidrug regimens, multiple routes of administration, as well as a variety of dosages based on the administration route (e.g. intravenous, intrathecal, oral, subcutaneous, intramuscular) further potentiates the risk for administration error (Sheridan-Leos, 2007). Previously researchers have recognized that chemotherapy errors can occur anywhere along the process, from prescribing, mixing, dispensing and administration (Sheridan-Leos, 2007; Vioral & Kennihan, 2012); however, recently researchers suggest that administration errors are most common (Dhamija, Kapoor, & Juneja, 2014). Due to the complex nature of chemotherapy administration, it is necessary to have in

place standardized chemotherapy administration protocols as well as education for nurses to ensure the safety of all patients.

The purpose of this review is to explore current guidelines and procedures used by organizations around the US to ensure the safety of patients and staff regarding administration of chemotherapy in order to reduce the risk of chemotherapy administration error.

Literature Review

Systematic Approach

The U.S. National Library of Medicine National Institutes of Health (PubMed) and Cumulative Index to Nursing and Allied Health Literature (CINAHL) electronic databases were searched for pertinent articles published between 2005 and 2015. Articles were chosen if they were printed in English and discussed methods/procedures used to ensure safe chemotherapy administration to oncology patients. Articles focusing on chemotherapy order entry and dispensing were excluded from the review. Keywords used: safe chemotherapy administration, guidelines, practices, oncology, pediatric oncology, nursing competence.

Nine articles met the inclusion criteria for the review including: one descriptive study, two practice guidelines, and six case reports.

Summary of Evidence

Recommendations for avoiding chemotherapy administration errors and improving patient safety call for standardized approaches to administering chemotherapy in in- and outpatient settings as well as development or revision of policies and procedures for system

improvement (Jacobson, Polovich, McNiff, LeFebvre, Cummings, Galioto, Bonelli, & McCorkle, 2009). Strategies suggested for standardizing administration of chemotherapy included adoption of clinical guidelines or curriculum set forth by professional organizations including the American Society of Clinical Oncology (ASCO), the Oncology Nursing Society (ONS), as well as the Association of Pediatric Hematology and Oncology Nurses (APHON) (Jacobson, et al., 2009; Kline, 2007; Neuss, Polovich, McNiff, Esper, Gilmore, LeFebvre, Schulmeister, & Jacobson, 2013). The literature supports the use of standardized didactic curriculum for nurses in addition to simulations involving patients receiving chemotherapy (Andam & Silva, 2008; Linnard-Palmer, 2012; Vioral & Kennihan, 2012). Clinical guidelines established by the ASCO, ONS, and APHON have been used since the mid-2000's and are recognized as standards of care for administering chemotherapy to oncology patients. The guidelines address topics related to treatment regimens and plans, drug preparation, supportive care measures, as well as management of drug toxicities (Kline, 2007; Vioral & Kennihan, 2012; Weingart, Li, Zhu, Morway, Stuver, Shulman, & Hassett, 2012).

Use of a multidisciplinary approach in order to create a culture of safety surrounding administration of chemotherapy was another common theme derived from the literature. The literature supports implementation of a multiple check/verification system of chemotherapy by at least two RNs prior to administration. An additional verification of the chemotherapeutic agent by a pharmacist is advised in multiple reports (Neuss et al., 2013; Robinson, Heigham, & Clark, 2006; Sheridan-Leos, 2007; Vioral & Kennihan, 2012).

Methods

The first set of practice guidelines used in this review was developed by the ASCO and the ONS and includes a list of 31 standards developed by a multidisciplinary steering group. The two professional groups recognized a need for a set of national standards regarding administration of chemotherapy in response to reports of chemotherapy administration errors. The ASCO and ONS standards for safe chemotherapy administration provide a framework for best practice and should be a goal for oncology care providers (Jacobson et al., 2009). In 2013, the ASCO and ONS updated their chemotherapy administration standards in response to increasing use of oral chemotherapy agents. Once again, a multidisciplinary steering group met to address concerns related to administration of oral agents and additional standards were developed. The new standards focus on importance of patient and family education regarding at-home administration schedules, how to store and dispose of oral chemotherapy agents, and the importance of monitoring and assessing for toxicities associated with oral agents (Neuss et al., 2013).

The majority of articles used in this review were case reports from institutions across the country regarding implementation of standards set forth by professional organizations. Vioral and Kennihan (2012) and Sheridan-Leos (2007) describe implementation of chemotherapy administration standards at large, suburban hospitals using a multidisciplinary approach. In both reports, organizers of change engaged members of multiple disciplines including nursing, medicine, pharmacy, administration and management to ensure successful implementation of new standards.

Andam and Silva (2008), Linnard-Palmer (2012), and Robinson et al. (2006) discussed methods employed to improve safety of chemotherapy administration to pediatric oncology patients. Andam and Silva (2008) used adult ONS chemotherapy administration guidelines and tailored them to the pediatric setting in a large urban children's hospital, while Linnard-Palmer (2012) used a combination of simulation scenarios and didactic education to ensure staff nurses as well as BSN nursing students in a teaching children's hospital were able to apply essential safety components of care to the child with cancer. Finally, Robinson et al. (2006) used a multidisciplinary approach to identify potential weaknesses in the chemotherapy administration process using the Failure Mode Effects Analysis (FMEA) at a large urban children's hospital. Following implementation of FMEA, a retrospective chart review of 221 charts over a three year span indicated that a 25% decrease in the number of administration errors.

Weingart et al. (2012) sought to assess the number of National Cancer Institute (NCI)-designated centers that had implemented the ASCO/ONC chemotherapy administration safety standards. Through a series of surveys, the researchers determined that more than half of the NCI-designated centers (n=31) had fully implemented that chemotherapy administration standards.

Strengths, Limitations and Gaps

The published guidelines from ASCO/ONS are thorough in nature and were developed by members of multiple disciplines. The latest updates address the fact that many of the newer chemotherapy agents can be given in oral form, on an outpatient basis. Researchers suggest the majority of cancer centers across the country have adopted the standards of care to guide in safe administration of chemotherapy and that institutions have recognized the need for

standardization in chemotherapy administration in order to ensure patient safety. Researchers further suggest reasons for non-adoption of the standards could be due to lack of resources including personnel and funding (Weingart et al., 2012).

The articles reviewed in this study were descriptive in nature and include practice guidelines which are lower levels of evidence (levels IV and V) according to Johns Hopkins Nursing Levels of Evidence (2012). The review may have been strengthened had there been published articles with higher levels of evidence including randomized controlled trials (RCTs) or systematic reviews of RCTs. While there are a number of reports documenting implementation of the standards in adult oncology settings, there is little literature pertaining to safe administration of chemotherapy in the pediatric oncology setting. Kline (2007) discusses development of the APHON Chemotherapy/Biotherapy Provider Course; however, there are no published reports on how this has affected patient outcomes in terms of reducing the number of chemotherapy administration errors or how the course has impacted nursing.

Implications for Practice

Policies need to address safe administration of chemotherapy and nurses need to be provided the knowledge to safely administer chemotherapy in order to ensure high-quality outcomes for patients (Vioral & Kennihan, 2012). The literature supports the use of a number of methods to ensure safety is a priority for patients and staff alike during the chemotherapy process. The strategies employed by Andam and Silva (2008) and Kline (2007) use a standardized curriculum to ensure nurses have the knowledge base and background needed to safely administer chemotherapy and biotherapy to patients. The APHON curriculum is specific to the pediatric oncology patient and addresses topics such as toxicity and symptom management

as well as psychosocial needs of the pediatric oncology patient. These topics were not covered by the ONS curriculum; however, nurses who completed evaluations for the ONS course expressed a need for pediatric-specific education (Andam & Silva, 2008). The multimodal system of learning used by Linnard-Palmer (2012) was embraced by participants who felt they attained a high level of skills through the patient simulation experience. Perhaps a simulation experience coupled with APHON's pediatric-specific didactic curriculum would offer nurses a comprehensive overview of how to safely administer chemotherapy and biotherapy to the pediatric oncology patient.

The other methods described in the literature as being successful involve forming a multidisciplinary team to evaluate and improve the chemotherapy process and implementation of template order sets. Common themes arise in the articles by Sheridan-Leos (2007), Robinson, Heigham, and Clark (2006), and Vioral and Kennihan (2012) including use of a proactive approach to identify weaknesses in a system before a catastrophic error occurs and importance of buy-in from all disciplines to improve a system with a high-risk for error.

Conclusion and Recommendation for Future Study

Institutions across the country have recognized the need to improve the system of chemotherapy administration. Administration of chemotherapy and biotherapy to a vulnerable population is a high-stakes process. The smallest error can lead to irreversible damage, and possibly death. A combination of the methods discussed in this review seems to be the best way to ensure the safety of the pediatric oncology patient. As a DNP prepared nurse, it is important to have a pulse on the learning needs of staff nurses and to advocate for opportunities for education and enrichment for those on the front-line regarding patient care. It is also important to recognize

the importance of the multidisciplinary team when evaluating the chemotherapy process. Each discipline plays a vital role in ensuring the safety of the pediatric oncology patient, serving as a checks-and-balance system to guarantee accuracy in all chemotherapy orders.

Future research may focus on qualifying the nurses' experience following completion and implementation of the APHON chemotherapy/biotherapy provider program. Additional research may also include measuring the cost savings a proactive approach to the chemotherapy process, or identification of weaknesses in the current chemotherapy administration process would incur.

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Analysis of Change: Implementation of the APHON Chemotherapy/Biotherapy Provider Course

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The Division of Pediatric Hematology/Oncology at the University of Kentucky in conjunction with Kentucky Children's Hospital recently revised the practice for educating nurses on safe administration of chemotherapy and biotherapy to pediatric oncology patients. This paper will discuss reasons behind the change as well as implementation and analysis on a microsystem level.

Background

The Institute of Medicine (IOM) (2000) reports approximately 7,000 deaths per year are related to medication error. Pediatric cancer patients experience fewer medication errors than other populations; however, when chemotherapy errors do occur, they generally have devastating effects (Sheridan-Leos, 2007). In a 2003 survey of nurses and pharmacists conducted by the IOM, chemotherapy ranked first in a list of high-alert medications. Survey participants perceived chemotherapy errors to have a higher risk of causing significant harm to patients than errors involving IV potassium chloride and insulin (IOM, 2003). Chemotherapy errors have the potential to be lethal because of a low therapeutic index and the lack of an antidote to reverse potential toxicities associated with chemotherapy errors.

Guidelines for safe administration of chemotherapy have been published by the Oncology Nursing Society and the American Society of Health-Systems Pharmacists; however, the Association of Pediatric Hematology and Oncology Nurses (APHON) recognized the need for tailored guidelines for the pediatric oncology patient population. In 2004, APHON introduced the Pediatric Chemotherapy and Biotherapy Provider Program with the goal of giving nurses the knowledge needed to safely and consistently administer chemotherapy and biotherapy. Since its inception, the APHON chemotherapy and biotherapy program has become the national standard

for teaching nurses how to administer chemotherapy and biotherapy to children and adolescents (Kline, 2007).

Prior to implementation of the APHON program, nurses at KCH attended a "homegrown" chemotherapy administration course. While this course was informative and nurses were considered competent to administer chemotherapy following its completion, it was not the method for teaching safe administration of chemotherapy and biotherapy to pediatric oncology patients employed at benchmark institutions around the country. Implementation of the APHON program not only gives nurse at KCH the most current information regarding safe, consistent administration of chemotherapy and biotherapy, it gives them the opportunity to gain APHON provider status, the national standard for administration of chemotherapy and biotherapy to pediatric oncology patients.

Plan and Implementation

Program

Implementation of the Association of Pediatric Hematology/Oncology Nurses (APHON) chemotherapy and biotherapy provider program began in October of 2013 at Kentucky Children's Hospital (KCH) so nurses would have the same knowledge base pertaining to pediatric chemotherapy and biotherapy as nurses in benchmark institutions around the country. As of April 2014, all current nursing staff who administer chemotherapy and biotherapy to pediatric oncology patients in KCH had successfully completed the APHON course.

The APHON Pediatric Chemotherapy and Biotherapy Provider Program is comprised of two 8-hour days of didactic teaching covering content related to differences between pediatric and adult cancers, clinical trials, administration of chemotherapy and biotherapy agents, side

effects, toxicity and symptom management, psychosocial issues, as well as legal and ethical issues. The course is co-taught in a classroom in KCH by two APRNs and two RNs (BSN). Following course completion, participants must pass a fifty question computerized test administered through the APHON website. A score of 80% or higher must be achieved in order for participants to achieve "provider status." All participants get to keep their text from the course and receive 13.75 CEUs for participation. Participants are also compensated for their time as they receive professional development pay for time spent in the APHON course.

Identification of Microsystem

The structure of a health care system includes a macrosystem which encompasses a system as a whole, multiple microsystems composed of front-line clinical units, and patient subpopulations in need of individualized care. The microsystem in this instance is the division of pediatric hematology/oncology, specifically nurses who administer chemotherapy to pediatric oncology patients. This microsystem is part of a large medical teaching facility (macrosystem). Microsystems are comprised of clinicians and support staff who work to meet patients' needs providing direct care, accessing systems, assessing patient and staff needs, establishing treatment plans, and evaluating outcomes over time (Nelson, Batalden, Huber, Mohr, Godfrey, Headrick, & Wasson, 2002). The advanced practice nurses and nurse coordinators within the division of pediatric hematology/oncology recognized a need to improve the knowledge base of front-line nurses responsible for administering chemotherapy to pediatric oncology patients. In order to expand the knowledge base and bring the teaching up to par with national standards, the group of nurses planned to implement the APHON Chemotherapy/Biotherapy Provider course so nurses would have the same knowledge base pertaining to pediatric chemotherapy and biotherapy as their peers across the country.

Major Stakeholders

Stakeholders involved in implementing the APHON Chemotherapy/Biotherapy Provider program include: advanced practice nurses (APRNs), staff nurses, nursing staff development, nurse managers, nursing administration, physicians, patients, and the healthcare facility.

Change Theory

In order to successfully implement the APHON Chemotherapy/Biotherapy Provider program, stakeholders needed to identify a change theory best suited to implement the planned change. Kurt Lewin identified three stages through which stakeholders must progress in order for change to become part of a system. Those stages include unfreezing, moving, and refreezing (Mitchell, 2013).

During the unfreezing phase, the APRNs and nurse coordinators examined the status quo regarding what staff nurses were being taught regarding safe administration of chemotherapy and biotherapy agents to pediatric oncology patients. This group of nurses determined that most pediatric oncology centers around the country had implemented the APHON Chemotherapy/Biotherapy Provider Program as a way of preparing their nurses to safely administer these agents to pediatric patients. The APRNs and nurse coordinators proposed the idea of implementing the APHON program to pediatric nursing administration, staff development, and the division chief for pediatric hematology/oncology. The proposal was made during a time of change in leadership in both nursing administration as well as within the division of pediatric hematology/oncology. Fortunately the new leaders fostered a sense of empowerment for nurses and the idea of expanding the knowledge base of nurses to ultimately improve the quality of care was embraced by nursing administration as well the division chief.

Furthermore, the chief of pediatric hematology/oncology approved the use of division funds to pay for the program.

Moving forward, the APRNs and nurse coordinators met regularly to determine when implementation would begin, how often they would teach the course in order to ensure all current staff as well as newly-hired staff had the opportunity to attend, and how many nurses should attend each course at a particular time. With the help of the pediatric acute care nurse manager, the group of nurses assigned all current staff as well as newly-hired staff (based on order of hire) a date to attending the two-day APHON program. Implementation began in October of 2013 and all current staff had successfully completed the program as of April 2014. Additional classes are now held on a quarterly basis for newly-hired RNs.

The division is currently in the refreezing phase or a phase of adoption and evaluation. The APHON program has been established and the new standard for teaching nurses how to safely administer chemotherapy and biotherapy to pediatric oncology patients. The APRNs, nurse coordinators, physicians and nursing administration are providing ongoing support to the front-line RNs administering chemotherapy on a daily basis. Stakeholders continue to evaluate the program to determine the knowledge base and beliefs of nurses regarding administration of chemotherapy/biotherapy to pediatric oncology patients one year post implementation of the APHON chemotherapy/biotherapy course. Additionally, stakeholders are interested in nurses' beliefs regarding the impact of nursing on safe administration of chemotherapy/biotherapy to pediatric oncology patients.

Analysis and Outcome

The APRNs and the nurse coordinators were the driving forces behind change in this situation; however, implementation of the APHON program would not have been successful without support from leaders in the microsystem as well as macrosystem. Mohr and Donaldson (2000) describe a high-quality microsystem as having the following characteristics: willingness to invest in improvement, training that provides for efficiency and staff satisfaction, interdependence of a care team whose goal is to meet patient needs, integration of information into work flow, ongoing outcomes analysis, and support from the larger organization (macrosystem). The leaders on a microsystem level were willing to invest in a program to give nurses the knowledge needed to safely administer chemotherapy to pediatric oncology patients, educate patients and families on treatment plans, and know that it is acceptable to ask questions of providers regarding treatment regimens. It is the hope of the APRNs and nurse coordinators who led the change that nurses will be able to integrate knowledge learned in the APHON program into daily practice.

Continuous process improvement is also a characteristic of a high-quality microsystem. In order to get a true measurement of how implementation of the APHON Chemotherapy/Biotherapy Provider Program has impacted nursing it will be important to gather feedback from the staff nurses. Under the current division chief, the microsystem has sought to empower nurses in hopes of encouraging a sense of ownership in the program. A sense of ownership in the program may foster a higher rate of fidelity regarding implementation of the principles learned in the APHON course.

Since implantation of the APHON program in October of 2013, fifty nurses have successfully completed the curriculum. The APHON program is now the required course for all

nurses who administer chemotherapy and biotherapy to pediatric oncology patients at Kentucky Children's Hospital. Nurses who currently hold the APHON Chemotherapy/Biotherapy Provider status must renew their credentials every two years by taking an online review course administered through APHON's website. Nurses who are newly hired must complete the APHON course within six months of their hire date in order to be able to administer chemotherapy to pediatric oncology patients.

Recommendations for Improving the Change Process

The APRNs and nurse coordinators proposed implementation of the APHON program in a climate that was open to change. The plan was well thought and purposeful and impacted both staff and patients. Retrospectively, it would have been ideal to have included a few staff nurses in the planning phase and proposal of the program to ensure members of all areas affected had a voice in the proposed plan. Fortunately, the staff nurses welcomed the opportunity to build on the knowledge they already possessed and embraced the change without resistance.

Feedback related to performance and outcomes, as well as, opportunities for the staff to discuss barriers to the process as well as how the program has impacted how they provide nursing care should be provided. Staff should be recognized for achieving targeted outcomes to help solidify the new practice. Ongoing monitoring and feedback will be critical to the long-term success of the APHON program.

Nursing Implications

Because of its high-alert status, it is imperative that all nurses who administer chemotherapy and biotherapy to pediatric oncology patients have the knowledge base needed to ensure safe administration with every patient, every time so potentially harmful errors can be avoided. Successful completion of the APHON Chemotherapy/Biotherapy provider course

ensures nurses are equipped with the knowledge and could serve as a stepping stone for nurses to pursue specialty certification through the Oncology Nursing Society (ONS) as a Certified Pediatric Hematology Oncology Nurse (CPHON).

The literature acknowledges the importance of adherence to guidelines when administering chemotherapy and biotherapy to pediatric oncology patients. However, since implementation of the APHON Pediatric Chemotherapy and Biotherapy Provider Program in 2004, there have been no published articles on the knowledge base of nurses following successful completion of the APHON program. Future research could focus on the relationship between successful completion of the APHON program and pursuit of specialty certification.

Conclusion

Implementing change is not an easy task. It is necessary to have a purposeful plan that is calculated and collaborative in nature. Identification of an appropriate change theory can be useful to ensure the planned change is accepted and endures. Support on multiple system levels as well as by-in from those affected by change are also critical components to successful plan implementation. Continuous process improvement that is patient and staff focused, empowering staff to share ideas and innovations, and providing continuous feedback regarding progress are all necessary in order for a plan to be successful and sustained.

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Pediatric Oncology Nurses' Knowledge of Safe Administration of Chemotherapy/Biotherapy

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Abstract

Aim: The purpose of this study is to assess nurses' knowledge and beliefs related to chemotherapy/biotherapy administration in the pediatric oncology population at least one year post implementation of the APHON chemotherapy/biotherapy provider course. Specifically, the principal investigator is interested in knowing if nurses feel they have been able to use the knowledge gained in the APHON course to positively impact the pediatric oncology patient.

Design: A descriptive design was used to describe associations between nurses' knowledge and beliefs regarding safe administration of chemotherapy/biotherapy to pediatric oncology patients. An invitation to a 26 item questionnaire, administered via Qualtrics was sent via secure email to all pediatric hematology/oncology nurses (inpatient and outpatient) who completed the APHON chemotherapy/biotherapy provider course as of April 2014.

Setting: A children's hospital within a large medical teaching facility including an ambulatory care clinic.

Participants: The study was open to all 35 registered nurses at the University of Kentucky (all at least 18 years of age) who had completed the APHON chemotherapy/biotherapy provider course as of April 2014.

Outcome Measure: Pediatric oncology nurses' knowledge of and confidence in administration of chemotherapy. Data were also analyzed to determine if there is a statistically significant difference between groups of nurses.

Results: Overall, participants reported a high level of knowledge regarding administration of chemotherapy/biotherapy to pediatric oncology patients; however, there were no significant

differences found in relation to total knowledge scores with age, education level, or with how long the participant has been an APHON provider.

Conclusion: Evaluation of the APHON chemotherapy/biotherapy program at least one year post participants' completion revealed high scores related to knowledge regarding safe administration of neoplastic agents to pediatric oncology patients.

Introduction

In 2015, approximately 10,400 children in the US under the age of 15 will be diagnosed with cancer. The introduction of multiple agent regimens of chemotherapy in the 1970's drastically improved the 5-year survival rate for pediatric oncology patients. Today, nearly 90% of children diagnosed with cancer will survive 5 years or more, compared to only 58% in the mid-1970's (American Cancer Society, 2015). Administration of chemotherapy is not without risk. Studies in pediatric oncology suggest a disturbingly high error rate ranging from 4% to 18%, and may cause devastating, if not lethal effects (Watts & Parsons, 2013).

Recommendations for avoiding chemotherapy administration errors and improving patient safety call for standardized approaches to administering chemotherapy in inpatient and outpatient settings as well as development or revision of policies and procedures for system improvement (Jacobson, Polovich, McNiff, LeFebvre, Cummings, Galioto, Bonelli, & McCorkle, 2009). In 2004, the Association of Pediatric Hematology and Oncology Nurses (APHON) introduced the Pediatric Chemotherapy and Biotherapy Provider Program. The intensive, two day, didactic program is intended to give nurses the knowledge needed to safely and consistently administer chemotherapy and biotherapy. Since its inception, the APHON chemotherapy and biotherapy program has become the national standard for teaching nurses how to administer chemotherapy and biotherapy to children and adolescents; however, since implementation of the standards, there have been no published reports on patient outcomes in terms of reducing the number of chemotherapy administration errors or how the course has impacted nursing (Kline, 2007).

Implementation of the APHON chemotherapy and biotherapy provider program began in October of 2013 at Kentucky Children's Hospital (KCH) and as of April 2014, all current nursing staff who administer chemotherapy and biotherapy to pediatric oncology patients in KCH had successfully completed the APHON course. The purpose of this program evaluation was to assess knowledge, beliefs and the impact nursing has had on chemotherapy/biotherapy administration one year post implementation of the APHON program.

Methods

The study took place in a children's hospital located within a large medical teaching facility and was approved by the University of Kentucky Institutional Review Board (UK IRB). The principal investigator (PI) was an instructor for the APHON course at the university and had access to participants' email addresses. Potential subjects had to be 18 years of age and had to have successfully completed the course by April 2014. Thirty-five potential subjects were identified as meeting these criteria and were sent an invitation via secure email to participate in an online survey. Subjects' identities were not linked to the survey as the invitation email to the survey contained an anonymous link to the Qualtrics survey. Qualtrics is a secure web-based application used to build and manage online surveys and databases. All data collected using Qualtrics are housed on secure servers and can be exported to various statistical software. No identifying information was tied to participants' responses.

Data Collection

The principal investigator (PI) sent an invitation via email to participate in a survey to 35 registered nurses who completed the APHON chemotherapy/biotherapy provider course as of April 2014. The email explained the purpose of the study and contained an anonymous link to

the Qualtrics survey. Completion of the survey was completely voluntary and in no way affects the participant's employment or performance evaluation as the PI does not supervise or evaluate any of the registered nurses. The survey was available for approximately two weeks, with a reminder email being sent to subjects after the survey had been open for one week.

Design

A cross-sectional, descriptive design was used in the twenty-six item questionnaire developed by the PI (Appendix C). The first five questions of the survey were related to demographics. Questions six through twenty-four asked participants to rate their knowledge of and confidence in administering chemotherapy using a Likert-type scale. The last two questions in the survey allowed for participants to articulate their experiences as APHON chemotherapy/biotherapy providers. According to DeVellis (2012) the Cronbach alpha coefficient of a scale should be above 0.7. The survey demonstrates good internal consistency with a Cronbach alpha coefficient of 0.84. The introductory email informed participants of no more than minimal risk involved in completing the survey, indicated consent by participating in the study, contained an anonymous link to the Qualtrics survey, and contained contact information for the PI as well as the University of Kentucky Office of Research Integrity. Participants could discontinue the survey at any point.

Outcome Measures

Pediatric oncology nurses' knowledge of and confidence in administration of chemotherapy were measured with a four-point, Likert-type scale with a total scale score of seventy-six. Correlation analysis was used to determine if there is a linear relationship between participants' ages and total score. Additionally, bivariate analysis was used to determine if participants' overall scores are related to education level and analysis of variance was used to

compare overall scores with years of pediatric oncology nursing experience as well as number of months the nurse has held the APHON provider status. The two open response questions at the end of the survey were intended to gain insight into the nurses' experiences as APHON chemotherapy/biotherapy providers.

Statistical Analysis

Descriptive statistics including means, medians and standard deviations were used. Data were analyzed using SPSS version 22.0 with a significance set at $p < 0.05$ for all results. Pearson product-moment correlation coefficient was used to determine if there was a relationship between participants' ages and overall score. Since the scores from the nineteen Likert-type questions followed a normal distribution, it was appropriate to perform parametric tests to determine whether there were statistically significant differences among groups. An independent-sample t-test was used to determine if there was a significant difference in the total score for associate degree nurses compared to nurses who have a bachelor's degree or higher. Finally, one-way analysis of variance (ANOVA) was used to determine if there was a difference in overall score related to 1.) experience as a pediatric oncology nurse measured in years or 2.) number of months participants have held the APHON provider status.

Study Results

A total of twenty-five (n=25) nurses completed the survey. Demographic data are presented in Table 1. Twenty-four of the twenty-five respondents were female. The mean age of participants was 37.6±8.7 years. The mean score from the 19 Likert-type questions was 69.2, with a median of 69, and a range of 59-76. There was a small, positive correlation with age of

participants and overall score (r = 0.11, p = 0.59). There was no significant difference in overall score related to academic degree level of respondents (p =0.79), number of years of experience (p =0.94), or number of months participants held the APHON provider status (p =0.12). Twenty three of the 25 (92%) participants strongly agreed that they have a personal responsibility for the safe administration of chemotherapy/biotherapy agents to pediatric oncology patients and that the RN is a critical final check prior to administration. Nearly all participants (96%) reported feeling confident in their ability to independently calculate a patient's body surface area (BSA) and verify an ordered chemotherapy/biotherapy dose based on the BSA.

Seventeen participants (68%) strongly agreed that continuing education related to reinforcement of knowledge related to safe administration of chemotherapy/biotherapy to pediatric oncology is important, while fourteen nurses (56%) strongly agreed that becoming an APHON chemotherapy/biotherapy provider has stimulated their interest in pursuing specialty certification as a certified pediatric hematology/oncology nurse (CPHON). Nearly all nurses (88%) reported ensuring a treatment roadmap accompanied a chemotherapy/biotherapy order every time. Additionally, all nurses (100%) reported they always double check chemotherapy/biotherapy doses with a second RN and if there is a question regarding the chemotherapy/biotherapy dose, they contact the nurse practitioner or attending physician for clarification; however, when asked specifically the level of comfortability one had in challenging a chemotherapy/biotherapy order they believed to be incorrect, only 16 (64%) of participants reported feeling comfortable.

In the open response portion of the survey, two nurses reported finding incorrect doses during the dose verification process (independent calculation of BSA and dose) and notified the

attending physician while others described being able to recognize side effects of drugs that they were unaware of prior to completing the APHON course. Furthermore, nurses reported feeling more confident in their ability to answer patients' and families' questions regarding drugs/side effects following completion of the APHON course.

Discussion

The high mean score of participants on the Likert-type questions indicates nurses feel knowledgeable regarding administration of chemotherapy and biotherapy to pediatric oncology patients and are confident in their ability to educate patients and families. The study revealed no significant statistical difference in overall score related to participant age, education level, nor amount of time the participant has held the APHON provider status. While the majority of respondents reported always following the APHON guidelines for safe administration of chemotherapy and biotherapy, 12% of participants reported ensuring the patient's roadmap accompanied the chemotherapy order most of the time. It would be interesting to know the reasons why this is not the case all of the time and further investigation into why this is not the standard practice 100% of the time is warranted. Furthermore, it is worth following up with nurses regarding their level of comfortability in challenging a chemotherapy/biotherapy order they believed to be incorrect. Perhaps reinforcing the notion that it is always acceptable to notify an attending or advanced practice nurse if there is question regarding a chemotherapy order would be beneficial.

The results of this study indicate the majority of participants are interested in continuing education related to safe administration of chemotherapy and biotherapy to pediatric patients

with 56% of participants indicating an interest in obtaining specialty certification. Planning is underway for a CPHON review course for nurses as a result of this feedback.

In the open response portion of the survey, participants were asked to describe a patient encounter in which he/she was totally confident in the decision made and how the knowledge obtained in the APHON course guided the decision. Of particular interest were the responses in which nurses recalled specific instances in which they caught an incorrect chemotherapy dose while independently calculating the patient's BSA against the ordered dose and appropriately notified the attending physician. Retrospectively, it would have been nice to know whether or not there was a difference in chemotherapy error rates (dose calculation or administration error) prior to implementation of the APHON program compared to points in time following implementation.

Limitations

Results of the study cannot be generalized due to the small sample size. No standardized questionnaire exists to address the aims of the study and a review of the literature did not reveal comparable studies. Although participation in the study was completely voluntary and in no way affected employment or performance evaluations, recall and self-report bias may have influenced the results. It should also be noted that a knowledge assessment regarding safe administration of chemotherapy was performed prior to implementation of the APHON course; however, this study was not planned at that time and IRB approval was not obtained for that assessment. The results of that assessment determined the need for a future educational intervention as several knowledge gaps were revealed and the PI was interested in specific administration procedures in

the post evaluation. Data regarding chemotherapy administration errors prior to and after implementation of the APHON course would have also enriched the study.

Conclusion

Evaluation of the APHON chemotherapy/biotherapy program at least one year post participants' completion revealed high scores related to knowledge regarding safe administration of antineoplastic agents to pediatric oncology patients. Data analysis revealed the desire for continuing education as well as interest in specialty certification, both of which will enrich nursing practice. It is encouraging to know that the majority of the time nurses are following the APHON standards for safe administration of chemotherapy; however, it should be reinforced that the standards apply to every patient, every time an antineoplastic agent is administered.

Table 1. Demographic characteristics of study nurses (*N* = 25)

Variable	***Mean* (*SD*) or *n* (%)**
Age	**37.6±8.7 years**
Gender	
Male	1(4%)
Female	24(96%)

Table 2. Bivariate associations among continuous demographic characteristics and knowledge

Variable	***r***	***p***
Age	0.11	0.59
...		

Table 3. Bivariate associations among categorical demographic characteristics and knowledge

Variable	*Mean* (*SD*)	*t* (*p*)
Nursing degree		
ADN	68.41(4.87)	0.79(0.44)
BSN/MSN	69.92(4.7)	
Years of experience as a pediatric Oncology nurse		
1-5 years	68.33(4.72)	0.06(0.94)
6-10 years	69(5.24)	
>10 years	69.2(4.54)	
Amount of time participant has held APHON provider status		
12-15 months	66.14(5.61)	2.3(0.12)
16-18 months	69.8(1.92)	
>18 months	70.62(4.5)	

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Practice Inquiry Report Conclusion

Because of its high-alert status, it is imperative that all nurses who administer chemotherapy and biotherapy to pediatric oncology patients have the knowledge base needed to ensure safe administration with every patient, every time so potentially harmful errors can be avoided. The literature acknowledges the importance of adherence to guidelines when administering chemotherapy and biotherapy to pediatric oncology patients and this practice inquiry project sought to improve the knowledge base of pediatric oncology nurses regarding safe administration of chemotherapy and biotherapy to pediatric oncology patients through implementation of the APHON Chemotherapy/Biotherapy provider course. Subsequent evaluation was performed to assess nurses' knowledge and beliefs related to chemotherapy/biotherapy administration at least one year post implementation of the APHON chemotherapy/biotherapy provider course revealing high scores related to knowledge concerning safe administration of neoplastic agents to pediatric oncology patients. Furthermore, data analysis revealed the desire for continuing education as well as interest in specialty certification, which has led to planning for a CPHON review course available in the fall of 2015.

Appendix A. Approval Letter from Institutional Review Board

UK
UNIVERSITY OF
KENTUCKY

Office of Research Integrity
IRB, IACUC, RDRC
315 Kinkead Hall
Lexington, KY 40506-0057
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Initial Review

Approval Ends
May 19, 2016

IRB Number
15-0331-P2H

TO: Leslee Bertram, MSN, APRN
Nursing Instruction
Pediatrics
J-455 KY Clinic
Speed Sort 0284
PI phone #: (859)218-0116

FROM: Chairperson/Vice Chairperson
Medical Institutional Review Board (IRB)

SUBJECT: Approval of Protocol Number 15-0331-P2H

DATE: May 22, 2015

On May 21, 2015, the Medical Institutional Review Board approved your protocol entitled:

Pediatric Oncology Nurses' Knowledge of Safe Administration of Chemotherapy/Biotherapy

Approval is effective from May 21, 2015 until May 19, 2016 and extends to any consent/assent form, cover letter, and/or phone script. If applicable, attached is the IRB approved consent/assent document(s) to be used when enrolling subjects. **[Note, subjects can only be enrolled using consent/assent forms which have a valid "IRB Approval" stamp unless special waiver has been obtained from the IRB.]** Prior to the end of this period, you will be sent a Continuation Review Report Form which must be completed and returned to the Office of Research Integrity so that the protocol can be reviewed and approved for the next period.

NOTE: *Please be reminded data / records must be retained for 6 years after study closure (revision number 8 was not addressed or it was not highlighted as requested).*

In implementing the research activities, you are responsible for complying with IRB decisions, conditions and requirements. The research procedures should be implemented as approved in the IRB protocol. It is the principal investigators responsibility to ensure any changes planned for the research are submitted for review and approval by the IRB prior to implementation. Protocol changes made without prior IRB approval to eliminate apparent hazards to the subject(s) should be reported in writing immediately to the IRB. Furthermore, discontinuing a study or completion of a study is considered a change in the protocol's status and therefore the IRB should be promptly notified in writing.

For information describing investigator responsibilities after obtaining IRB approval, download and read the document "PI Guidance to Responsibilities, Qualifications, Records and Documentation of Human Subjects Research" from the Office of Research Integrity's IRB Survival Handbook web page [http://www.research.uky.edu/ori/IRB-Survival-Handbook.html#PIresponsibilities]. Additional information regarding IRB review, federal regulations, and institutional policies may be found through ORI's web site [http://www.research.uky.edu/ori]. If you have questions, need additional information, or would like a paper copy of the above mentioned document, contact the Office of Research Integrity at (859) 257-9428.

Ellen Hahn, RN, PhD
Larry Cunningham, MD, DDS /jh
Chairperson/Vice Chairperson

Appendix B. Survey Invitation Email

Dear APHON Chemotherapy/Biotherapy Provider,

You have been an APHON Chemotherapy/Biotherapy Provider for at least one year. We hope you learned valuable information from the course that has helped you become more confident in the care you provide. We are interested in knowing if nurses feel they have been able to use the knowledge gained in the APHON course to positively impact the pediatric oncology patient.

Although you will not get personal benefit from taking part in the research study, your responses may help us understand more about how nurses feel they have been able to use the knowledge gained from the APHON Chemotherapy/Biotherapy Provider Course.

We hope to receive questionnaires from about 50 people, so your answers are important. Of course, you have a choice about whether or not to complete the survey, but if you do participate, you are free to skip any questions or discontinue at any time. Participation will in no way affect your employment or performance evaluation.

The survey will take approximately 20 minutes to complete.

There are no known risks to participating in this study.

Your responses to the survey will be kept confidential to the extent allowed by the law. When we write about the study, you will not be identified.

Please be aware, while we make every effort to safeguard your data once received from the online survey/data gathering company, given the nature of online surveys, as with anything involving the Internet, we can never guarantee the confidentiality of the date while still on the survey/data gathering company's servers, or while en route to either them or us. It is also possible the raw data collected for research purposes may be used for marketing or reporting purposes by the survey/data gathering company after the research is concluded, depending on the company's terms of service and privacy policies.

If you have any questions about the study, please feel free to ask; my contact information is given below. If you have complaints, suggestions, or questions about your rights as a research volunteer, contact the staff in the University of Kentucky Office of Research Integrity at 859-257-9428 or toll-free at 866-400-9428.

Thank you in advance for your assistance with this project. The survey will be open for 2 weeks. You will receive this email again in one week as a reminder the survey is only open for one more week if you choose to complete.

Please click the following link if you wish to participate: https://az1.qualtrics.com/ControlPanel/

Sincerely,

Leslee Bertram
College of Nursing, University of Kentucky
859-218-0116
leslee.bertram@uky.edu

Appendix C. Survey

What is your gender?
Male
Female

What is your age in years?
_____

What is your highest nursing degree?
ADN
BSN
MSN
DNP
PhD in nursing

How many years of experience do you have as a pediatric oncology nurse?
Less than 1 year
1-5 years
6-10 years
Greater than 10 years

How long have you held the APHON chemotherapy/biotherapy status?
12-15 months
16-18 months
More than 18 months

Please rate the degree to which you agree or disagree with the following statements.

I am comfortable reviewing and understand Children's Oncology Group (COG) roadmaps.

Strongly Disagree
Disagree
Agree
Strongly Agree

I believe that as an RN I play a crucial role in educating my patients and families regarding the side effects of specific chemotherapy/biotherapy agents.

Strongly Disagree
Disagree
Agree

Strongly Agree

I believe the RN is a critical final check prior to safely administering chemotherapy/biotherapy agents.

Strongly Disagree
Disagree
Agree
Strongly Agree

I feel a strong personal responsibility for the safe administration of chemotherapy/biotherapy agents to pediatric oncology patients.

Strongly Disagree
Disagree
Agree
Strongly Agree

I am confident in my ability to educate patients and families regarding the side effects of specific chemotherapy/biotherapy agents.

Strongly Disagree
Disagree
Agree
Strongly Agree

I understand the importance of patients' participation in clinical trials as part of the COG research cooperative.

Strongly Disagree
Disagree
Agree
Strongly Agree

I believe the RN plays an important role in facilitating patients' participation in COG clinical trials.

Strongly Disagree
Disagree
Agree
Strongly Agree

I believe it is critical to review the patients' roadmaps prior to administering any chemotherapy/biotherapy.

Strongly Disagree
Disagree
Agree
Strongly Agree

I am confident in my ability to independently calculate a patient's body surface area (BSA) and verify chemotherapy/biotherapy doses based on the BSA.

Strongly Disagree
Disagree
Agree
Strongly Agree

I am confident in my ability to recognize and mange toxicities related to chemotherapy/biotherapy agents in pediatric oncology patients.

Strongly Disagree
Disagree
Agree
Strongly Agree

I am familiar with the appropriate chain of command to whom I can address questions or concerns regarding chemotherapy/biotherapy agents.

Strongly Disagree
Disagree
Agree
Strongly Agree

I am comfortable challenging a chemotherapy/biotherapy order I believe is incorrect.

Strongly Disagree
Disagree
Agree
Strongly Agree

I feel valued as a professional member of the pediatric oncology healthcare team.

Strongly Disagree
Disagree
Agree
Strongly Agree

I am confident in my ability to safely administer chemotherapy/biotherapy to pediatric oncology patients.

Strongly Disagree
Disagree
Agree
Strongly Agree

Please rate the degree to which you do or do not do the following.

I ensure the roadmap accompanies the chemotherapy/biotherapy order.

All of the time
Most of the time
Never

I double check the chemotherapy/biotherapy doses with another RN.

All of the time
Most of the time
Never

If there is a question regarding a chemotherapy/biotherapy dose or start time, I contact the nurse practitioner or attending physician.

All of the time
Most of the time
Never

The following questions will allow you the opportunity to tell us more about your experience as an APHON chemotherapy/biotherapy provider.

Please describe how becoming an APHON chemotherapy/biotherapy provider has made you a more confident nurse.

Now that you are an APHON chemotherapy/biotherapy provider, you have the knowledge to be more confident in the care you provide. Please share a story regarding a specific patient encounter (do not give names or identifiers) in which you felt totally confident in the decisions you made and the care you provided. Be specific regarding how the knowledge obtained in the APHON course guided the care you provided. Do not be humble.

Thank you for completing the survey.

You may direct questions or complaints regarding this survey to the principal investigator, Leslee Bertram, at leslee.bertram@uky.edu

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