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Improving Patient Safety With Error Identification in Chemotherapy Orders by Verification Nurses

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Abstract

Background—The prevalence of medication errors associated with chemotherapy administration is not precisely known. Little evidence exists concerning the extent or nature of errors; however, some evidence demonstrates that errors are related to prescribing. This article demonstrates how the review of chemotherapy orders by a designated nurse known as a verification nurse (VN) at a National Cancer Institute–designated comprehensive cancer center helps to identify prescribing errors that may prevent chemotherapy administration mistakes and improve patient safety in outpatient infusion units.

Objectives—This article will describe the role of the VN and details of the verification process.

Methods—To identify benefits of the VN role, a retrospective review and analysis of chemotherapy near-miss events from 2009–2014 was performed.

Findings—A total of 4,282 events related to chemotherapy were entered into the Reporting to Improve Safety and Quality system. A majority of the events were categorized as near-miss events, or those that, because of chance, did not result in patient injury, and were identified at the point of prescribing.

Keywords

chemotherapy errors; prescribing errors; medication errors; verification nurse; chemotherapy administration; patient safety

The exact pervasiveness of medication errors linked to the administration of chemotherapy is unknown (Bonnabry et al., 2006; Gandhi, Weingart, et al., 2005; Ranchon et al., 2012), and a national benchmark for chemotherapy-related errors does not exist (Walsh et al., 2009). Surprisingly little evidence is available about the extent or nature of these errors, which demonstrates how safety issues related to the administration of chemotherapy are under-researched (Kullberg, Larsen, & Sharp, 2013). Despite the lack of research, some evidence suggests that errors are related to prescribing (Aita et al., 2013; Ranchon et al., 2012).

In 1995, a report of a patient death from an overdose of chemotherapy at a major medical center prompted many cancer centers to reexamine their processes for safe chemotherapy administration (Schulmeister, 2005). At the same time, care delivery shifted significantly from the inpatient to the outpatient setting, presenting new challenges related to higher volumes, time constraints, and lower levels of clinician control (Gandhi, Bartel, et al., 2005). The heightened awareness of the risks in chemotherapy administration processes brought on by this major error, coupled with the transition of care to the outpatient setting, hastened the need to explore ways to reduce risk and increase safety in chemotherapy prescribing, dispensing, and administration.

Measures to reduce the incidence of medication errors range widely, such as the implementation of computerized physician order entry (CPOE), computerized clinical decision support systems, standardization of prescribing vocabulary, communication improvements, and barcode technology (Ranchon et al., 2012; Schulmeister, 2005; Watts & Parsons, 2013). Recommendations like CPOE may improve safety related to the use of standardized templates, as well as the opportunity to imbed alerts when deviations from the guidelines occur (Bonnabry et al., 2006; Cheng et al., 2012; Kullberg et al., 2013). However, the sophistication of such a system is largely dependent on the extent to which it is maintained and updated. The system's implementation can further influence its function by allowing advanced entry of orders and copying of previous orders to a future date if these orders are identical.

Although the actual rate of chemotherapy errors reported in the literature is low (Walsh et al., 2009; Watts & Parsons, 2013), the margin of error allotted when administering toxic, antineoplastic drugs to patients with cancer is very small. Therefore, identifying prescribing errors prior to treatment may reduce the risk of patient harm during chemotherapy administration. One way to identify prescription errors is to implement processes to verify chemotherapy orders before administration.

In 2009, the American Society of Clinical Oncology (ASCO) and the Oncology Nursing Society (ONS) created standards for the safe administration of chemotherapy to adult patients in the outpatient setting; these standards were revised in 2012 (Jacobson et al., 2012). One standard indicates that a second person should independently verify each order for chemotherapy before preparation (Jacobson et al., 2012).

This article will demonstrate how Memorial Sloan Kettering Cancer Center, a National Cancer Institute–designated comprehensive cancer center located in New York City, implemented a process in which all chemotherapy orders are reviewed by a designated nurse known as a verification nurse (VN), meeting the ASCO/ONS standards for safe chemotherapy administration. This article will describe the VN's role in helping to identify prescribing errors to prevent chemotherapy administration errors and improve patient safety in outpatient infusion units. As cancer care continues to shift to the outpatient setting and trends in patient volume increase, oncology settings need to create processes that respond to this growth while ensuring safe delivery of treatment.

Background

Located in a large metropolitan area, the comprehensive cancer center discussed in the current article is comprised of six outpatient sites dispersed across the city. Each site includes clinics and infusion suites of varying sizes, with the largest site housing about 75 treatment chairs. Each year, about 130,000 chemotherapy visits are completed in these outpatient settings; this is a number that has increased each year since 2009 (see Figure 1). Treatments include multidrug, multiday regimens and investigational agents.

At this center, care is provided to patients diagnosed with all types of cancers. To provide comprehensive specialized care, the inpatient and outpatient units are organized by disease management teams (DMTs). Clinician teams—which include nurses, physicians, social workers, and pharmacists—within each DMT demonstrate expertise in caring for patients diagnosed with a specific cancer. VNs work with designated DMTs and develop expert knowledge of the specific treatment regimens for those diseases. This knowledge enhances their ability to review and verify chemotherapy orders for accuracy.

When reviewing chemotherapy orders, VNs ensure completeness and accuracy of the orders, including correct drug, dose, route, frequency, and duration of treatment. If a discrepancy is noted, VNs communicate with the prescriber to facilitate corrections. VNs then submit an event report labeling the error as a “near miss” to the institution’s electronic database: the Reporting to Improve Safety and Quality (RISQ) system. A “near miss” is defined as “an event or situation that did not produce patient injury, but only because of chance” (Near miss, n.d.).

The Role and Competencies of the Verification Nurse

The role of the VN is best described through the competencies required, details of the verification process and the staffing model, and the impact on financial and clinical outcomes. VNs, who are typically experienced nurses at the clinical nurse III or clinical nurse IV level on this institution’s clinical ladder, demonstrate advanced knowledge and proficiency in nursing care delivery. Being an oncology certified nurse through the Oncology Nursing Certification Corporation (ONCC) and having a bachelor of science degree in nursing are required. Although not required, many VNs have completed the ONS/ONCC Chemotherapy Biotherapy Certificate Course. VNs must have strong leadership skills and the ability to effectively communicate with members of a multidisciplinary team.

In addition to reviewing chemotherapy orders, VNs participate in several multidisciplinary activities, as well as in the creation, review, and revision processes of new and current chemotherapy and biotherapy guidelines. These guidelines serve as a resource to healthcare providers, including nurses and pharmacists. VNs also actively participate in quality improvement (QI) initiatives, many of which stem from their submitted event reports. With intimate knowledge of the treatment regimens, VNs also serve as resources to nurses administering chemotherapy regimens.

Each VN completes a comprehensive orientation that is 8–12 weeks in duration. During this time, VNs are paired with experienced preceptors who teach and mentor them to meet the

expectations of the role (see Figure 2). On completion of the initial orientation and annually afterward, VNs must demonstrate competency in the use of clinical information systems (CISs), in knowledge of the verification process as outlined by policy, and in the ability to contribute to unit operations. All VNs' competencies are evaluated annually by peer review (another VN) or by a clinical nurse specialist and documented on a competency form (see Figure 3).

Order Verification Workflow

Chemotherapy cannot be mixed before the order is reviewed by a VN. The verification process involves a team that includes physicians, nurses, pharmacists, and administrative staff. Although VNs have a pivotal role in this process, each member of the team contributes something important.

All chemotherapy orders are entered electronically onto a drug-specific electronic adult treatment order template. All orders are written by an attending physician, nurse practitioner, physician assistant, or fellow, with orders written by the latter three having to be cosigned by an attending physician credentialed to prescribe chemotherapy at this center.

Once chemotherapy orders are entered into the CIS, the order receives a status of "pending chemo RN verification," and then populates a "waiting to be verified" patient list in the CIS. VNs are responsible for reviewing each chemotherapy order to ensure its completeness and accuracy (defined as correct drug, dose, frequency, route, duration, and treatment). After the chemotherapy order is verified, the order status becomes "pending registered pharmacist verification" and the order is electronically moved to prompt a pharmacist to verify the order. Throughout this workflow, administrative staff members support the process by communicating pertinent information (e.g., patient arrivals, blood test results, newly entered orders) to VNs to expedite the workflow. If a discrepancy is noted within the chemotherapy order, VNs investigate the cause by contacting the healthcare provider for clarification or correction.

Clarification

The healthcare provider may have changed the care plan midtreatment without providing a written explanation. The VN ascertains the reason for the treatment deviation and shares this information with the pharmacist and treating nurse. In one scenario, the VN is reviewing an order for cyclophosphamide, doxorubicin, vincristine, prednisone, or CHOP, which is a commonly used regimen for lymphomas. The patient is on his fourth cycle, and the vincristine dose has changed from being weight based to capped at 2 mg. The healthcare provider did not write a note on the order explaining the rationale for the change; therefore, the VN contacts the healthcare provider for clarification. The VN discovers that the patient had reported a new onset of peripheral neuropathy, resulting in the physician's decision to cap the dose. This information is then shared with the pharmacist and treating nurse.

Correction

The healthcare provider may have deviated from treatment guidelines or prescribed in error. The VN contacts the provider and determines that an error in prescription occurred. A new

order is entered and verified by the VN. The VN enters a near-miss event into the RISQ system.

Once the VN has verified the order, a pharmacist reviews the order for accuracy and completeness before the drug is mixed and delivered to the chemotherapy unit; this process is detailed in Figure 4. The pharmacy essentially replicates the work performed by the VN, providing additional interdisciplinary support to ensure the safe administration of chemotherapy. The pharmacy then delivers the drugs to the treatment unit. Prior to chemotherapy administration, the treating nurse reviews and verifies the treatment plan, medical record, drug, dose, and schedule, as entered in the CIS physician order. The treating RN also ensures that the patient's laboratory results meet treatment parameters because the VN and pharmacist verification may be completed prior to availability of laboratory results. In addition, the treating nurse and another licensed healthcare professional follow the patient identification process, compare the labeled agent to the order for accuracy, and confirm that the laboratory results are within parameters.

Review of Error Data

The RISQ system serves as a reporting mechanism to track events and helps to support an environment of QI and self-reporting. Events are categorized by severity: Level 0 equals near miss, level 1 no harm, level 2 temporary harm, level 3 significant harm, and level 4 death. To illustrate benefits of the VN role, chemotherapy events entered into the RISQ system from 2009–2014 were reviewed (see Table 1). One limitation concerning the review of this data is that the RISQ system is based on staff self-reports.

From January 2009 to December 2014, almost 700,000 patient chemotherapy visits occurred, and about 1 million chemotherapy orders were prescribed and reviewed by VNs (see Figure 5). This volume continues to grow. During that time, 3,767 level 0 events related to chemotherapy were entered into the RISQ system; this represents about 0.4% of the total orders in that time period. The majority of these near misses were identified at the point of prescribing. The most frequently entered near-miss events were incorrect dose, wrong frequency or day of treatment, wrong drug, incomplete order, and protocol deviation. A direct correlation exists between the continuous increase in chemotherapy orders and patient volume with the number of level 0 events VNs capture.

From 2009–2014, 506 chemotherapy-related events, out of 700,000 patient chemotherapy visits, were entered as level 1 events; this number represents about 0.07% of all chemotherapy visits during that time period. The majority related to the wrong rate of drug administration by a treatment nurse or a delay in treatment. Only nine events were entered as level 2 events, and no level 3 or level 4 events were entered into the RISQ system. In 2010 and 2012, an increase in events reported as near misses into the RISQ system was noted. No clear factor has been identified as contributing to the events reported; however, an inference can be made that the increase resulted from an increase in patient chemotherapy visits during both years.

Considering the high volume of chemotherapy visits, these numbers translate into a low rate of error. Rate was calculated by comparing the total number of RISQ events entered annually to annual chemotherapy visit volume. Level 0 events were entered at a rate of 0.6%, level 1 events at a rate of 0.08%, and level 2 events at a rate of 0.001%; these percentages help to illustrate how chemotherapy visit volume continues to increase, yet rate of errors remains low.

These data are significant in demonstrating the value of the VN role in contributing to the safe delivery of chemotherapy. VNs help to minimize errors by identifying potential errors prior to the point of service. The current authors believe that the VN process is an important step, as demonstrated by the low level of chemotherapy-related errors.

Discussion

The delivery of chemotherapy is a high-risk clinical activity, meaning that the potential for patient harm can be great. The employment of safeguards and standardized protocols is imperative to ensure the accurate prescribing and administration of chemotherapy treatments (Jacobson et al., 2012). The implementation of the VN workflow as an additional safety standard has demonstrated its unique contribution to enhancing the safe delivery of chemotherapy. The value of VNs is validated by their high rate of identifying errors, most commonly in prescribing, prior to the point of service. The literature supports the use of independent double checks as a means to improve safety. The ASCO/ONS safety standards specifically highlight designating personnel to independently verify chemotherapy orders prior to preparation (Jacobson et al., 2012). The Institute for Safe Medication Practices ([ISMP], 2013) suggested that independent double checks should be used for selective high-risk or high-alert medications. The ISMP (2013) noted that the selective and proper use of independent double checks can play an important role in medication safety. In addition, the ISMP stressed the importance of conducting a comprehensive review of the medication order rather than simply comparing product to order; doing so has been determined to be valuable in catching prescribing errors. VNs employ this comprehensive review by checking orders for completeness and accuracy, and then evaluating the appropriateness of the drug with regard to the patient's diagnosis and treatment plan as laid out by the physician.

On the surface, the role of the VN may appear redundant, and some evidence suggests that redundancy in workflows may not improve safety because some accidents are unavoidable (Saubermann & Lagasse, 2012). Although the elimination of all errors may not be realistic, the role of the VN provides additive and unique value to the chemotherapy workflow. Further analysis of this workflow and other comparative processes will continue to help prove the worth of this workflow.

VNs participate in QI initiatives with multidisciplinary team members because the VNs are seen as clinical experts. This work often stems from VNs' identification of a near miss and submission of an event report. Evaluating these reports is important for continuous system improvement. QI initiatives can lead to implementing modifications in workflows, order sets, and chemotherapy guidelines to further enhance patient safety.

Implications for Nursing

The evidence suggests that the implementation of safety standards and processes to help prevent chemotherapy administration errors improves patient safety and ensures the delivery of quality care. Recommendations to improve safety include creating standardized processes, strictly adhering to policies and procedures, and routinely performing interdisciplinary reviews of errors to identify areas for improvement (Jacobson et al., 2012). In addition, the implementation of electronic systems (e.g., CPOE, e-prescribing, electronic health records) can lead to improvement of the chemotherapy ordering and administration process (Jacobson et al., 2012; Ranchon et al., 2012; Watts & Parsons, 2013). Implementation of the VN role augments the safety advantages provided by these systems.

The ASCO/ONS safety standards (Jacobson et al., 2012), as well as those of the ISMP (2013), specifically highlight the use of independent verification of chemotherapy orders prior to preparation. In the workflow of the comprehensive cancer center discussed in this article, these standards are met by the implementation of the VN role. Institutions interested in implementing the VN role should evaluate their current chemotherapy prescribing error rate, resources, internal workflows, and volume to determine if this type of role would add value to the prevention of prescribing errors.

A comparative analysis of a similar workflow would be valuable in objectively evaluating the role of the VN in the chemotherapy workflow. The ISMP (2013) suggested that not all high-risk or high-alert medications need to be part of a double-check process because lack of time and resources may be an issue at some institutions. In addition, the ISMP (2013) advised against simply adding double checks as a means of fixing a workflow that requires a system redesign. Therefore, a thorough evaluation of any current processes should be performed prior to implementing a VN-type workflow.

Conclusion

The data from this comprehensive cancer center suggest that the VN role contributes to improving safety in the administration of chemotherapy. VNs collaborate closely with the prescribing physician, pharmacist, and treating nurse to identify errors, reducing potential and actual errors at the point of service and promoting efficiency in the workflow of treatment. A secondary outcome is the reduction of delays in treatment and associated wait times, enhancing patient experience and maximizing the performance in large-volume chemotherapy units.

As the healthcare environment expands in volume and complexity, new challenges must be faced in the delivery of quality cancer care to patients. The administration of chemotherapy in a safe and effective manner is of high importance but continues to be underresearched. The lack of national benchmarks for safety in this area makes comparison of systems difficult to evaluate. The literature is clear that implementing standardized systems can facilitate safer chemotherapy administration (Ranchon et al., 2012; Schulmeister, 2005; Watts & Parsons, 2013). The integration of the VN role into the chemotherapy workflow at

the comprehensive cancer center discussed in this article has been successful in minimizing errors and maintaining safety in the chemotherapy administration process.

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Implications for Practice

- ▶ Use the standards created by the American Society of Clinical Oncology and the Oncology Nursing Society for the safe administration of chemotherapy to adult patients in the outpatient setting to optimize patient safety.
- ▶ Implement independent verification of chemotherapy orders prior to preparation to minimize errors.
- ▶ Understand that success of the verification nurse role is dependent on standard orientation and annual competencies, which are evaluated through a peer review process.

FIGURE 1.
Annual Chemotherapy Visit Volume

Patient- and Family-Centered Care

At the end of orientation, the VN will recognize the patient and his or her family as full partners in providing compassionate and coordinated care based on respect for individualized, patient population-specific preferences, values, and needs. The VN will integrate the knowledge and skills necessary to provide appropriate care based on the age, disease process, cultural and language, spiritual, health literacy, and gender and sexual orientation needs of the population served.

Competency	Completed	Initials	Date
Verbalizes knowledge of conventional treatments for specific diseases			
Verbalizes knowledge of protocol-specific criteria for eligibility			
Verbalizes knowledge of protocol-specific criteria for treatment regimens and supportive medications			
Verbalizes knowledge of identification of patients whose chemotherapy could be premixed using established criteria			

Teamwork and Collaboration

At the end of orientation, the VN will function effectively within nursing and interprofessional teams, fostering open communication, mutual respect, and shared decision making to achieve quality patient care.

Competency	Completed	Initials	Date
Coordinates staffing schedule for VNs in collaboration with unit nurse leader, clinical nurse specialist, and charge nurse			
Acts as a resource for chemotherapy unit nursing staff and pharmacy staff, providing clarification of orders and treatment plans			
Manages the "sick line" and alerts the treatment units and nurse leader			
Attends daily "counts" meetings and works in collaboration with members of leadership and administration			

Evidence-Based Practice

At the end of orientation, the VN will integrate best current evidence with clinical expertise in the delivery of care based on preferences, values, and needs specific to the patient population.

Competency	Completed	Initials	Date
Demonstrates understanding of institutional chemotherapy standards and guidelines as evidenced by passing score on institutional chemotherapy and biotherapy examination			

Quality Management and Performance Improvement

At the end of orientation, the VN will demonstrate knowledge of data management, the change process, and his or her role in continuously improving the quality and safety of healthcare delivery.

Competency	Completed	Initials	Date
Reviews the adult treatment order and ensures that all sections are completed			
Reviews the adult treatment order and ensures that all information is accurate			
Reviews laboratory results and verifies against parameters			
Handles and processes orders that require clarification			
Records and reports type errors, which are entered into the Reporting to Improve Safety and Quality system			

Safety

At the end of orientation, the VN will demonstrate effective integration of safety measures that minimize risk of harm to patients, visitors, and colleagues.

Competency	Completed	Initials	Date
Demonstrates clinical competency in the verification process as per the institution's VN policy			
Verifies dosing information per institutional guidelines, protocol, or pertinent documents			

Nursing Technology and Informatics

At the end of orientation, the VN will use technology and nursing informatics to gather and communicate data more effectively, enhance safe delivery of patient care, and improve his or her knowledge base.

Competency	Completed	Initials	Date
Accesses chemotherapy and biologic therapy guidelines			
Accesses chemotherapy and biologic therapy dose calculators			
Demonstrates the use of biologic therapy dose calculators			
Accesses the clinical research database to ensure patients' protocol registration and eligibility			
Accesses research protocols via the protocol web page			
Accesses clinical information systems, electronic medical records, pharmacy profiles, laboratories, and significant events			
Accesses the Reflection Lab system			
Uses email for communication			
Demonstrates how to maneuver in and out of all of the above programs ("toggle"), using the minimize feature on the computer			

FIGURE 2.

Verification Nurse (VN) Orientation Competencies

Note. Courtesy of Memorial Sloan Kettering Cancer Center Department of Nursing Education. Adapted with permission.

Competency	Outcome	Method of Evaluation	Evaluated By	Signature/Title/Date
Applies verification workflow process as per policy		Demonstration and discussion	CNS/peer review	
Verifies eATO for accuracy		Demonstration and discussion	CNS/peer review	
Identifies the process for clarifying unclear orders		Demonstration and/or discussion	CNS/peer review	
Verifies treatment dose and schedule for standard treatments		Demonstration and discussion	CNS/peer review	
Reviews laboratory results and verifies them against parameters		Demonstration and discussion	CNS/peer review	
Demonstrates use of chemotherapy dose calculators		Demonstration	CNS/peer review	
Demonstrates process for cancellations of treatment, no-shows, and change of treatment		Demonstration	CNS/peer review	
Demonstrates use of eATO, eMAR, RISQ reporting, and clinical documentation		Demonstration	CNS/peer review	
Identifies chemotherapies that can be premixed		Demonstration	CNS/peer review	
Verifies adherence of protocol guidelines for eligibility criteria, treatment plan, and dose modification		Demonstration and discussion	CNS/peer review	
Demonstrates knowledge of CTC		Demonstration	CNS/peer review	
Identifies need for dose modification using CTC grading criteria		Demonstration and discussion	CNS/peer review	

CNS—clinical nurse specialist; CTC—common toxicity criteria; eATO—electronic adult treatment order; eMAR—electronic medication administration record; RISQ—Reporting to Improve Safety and Quality

FIGURE 3.

Verification Nurse Annual Competency

Note. Courtesy of Memorial Sloan Kettering Cancer Center Department of Nursing Education. Adapted with permission.

1. The chemotherapy order is entered electronically on an eATO by a provider.
 2. The order status in CIS changes to "pending RN verification."
 3. The order populates a "waiting to be verified" list for the VN.
 4. The VN verifies the order for completeness and accuracy.
 5. The order status changes to "pending RPH verification."
 6. The order populates a "waiting to be verified" list for the pharmacist.
 7. The pharmacist verifies the order for completeness and accuracy.
 8. The order status changes to "waiting to be mixed." A prompt is then sent to a pharmacist for mixing.
 9. The drug is sent to the treatment unit.
- CIS—clinical information system; eATO—electronic adult treatment order; RPH—registered pharmacist; VN—verification nurse

FIGURE 4.
Order Verification Workflow

FIGURE 5.
Annual Chemotherapy Order Data

TABLE 1

Annual Reporting to Improve Safety and Quality System Data by Event Type (2009–2014) Compared to Annual Patient Chemotherapy Visit Volume

Year	Level 0 (Near Miss)		Level 1 (No Harm)		Level 2 (Temporary Harm)		Level 3 (Significant Harm)		Level 4 (Death)	
	n	%	n	%	n	%	n	%	n	%
2009	581	0.09	59	0.008	2	0.0002	–	–	–	–
2010	757	0.11	69	0.01	–	–	–	–	–	–
2011	557	0.08	105	0.02	4	0.0006	–	–	–	–
2012	728	0.11	89	0.01	1	0.0001	–	–	–	–
2013	553	0.08	94	0.01	–	–	–	–	–	–
2014	591	0.09	90	0.01	2	0.0002	–	–	–	–
Total	3,767	0.5	506	0.07	9	0.0013	–	–	–	–

Note. Percentage rate was calculated by comparing the total number of Reporting to Improve Safety and Quality system events entered annually to annual patient chemotherapy visit volume.