JOURNAL OF INTERNATIONAL CRISIS AND RISK COMMUNICATION RESEARCH
ISSN: 2576-0017
2024, VOL 7, NO S3

Integration of Nursing and Pharmacy in Enhancing Healthcare Quality in Operating Rooms: Challenges and Innovative Solutions

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1. Introduction

Operating rooms are undoubtedly impact sites of healthcare quality. The integration of nursing, perhaps the largest productive domain, and pharmacy, a critical domain, is the update of the allocation and combination of resources to achieve a given level of outcomes that can be accomplished given constraiundoubtedly impact the quality of healthcare sitesnts of the health systems. Unfortunately, contemporary health systems still do not possess the desired cooperation, which could reflect themselves as improved outcomes, both quantitative and qualitative in these domains. Surgical boundaries are swiftly evolving due to advancing medical technologies and continually changing standards. Considerable transformations are essential to move from profession-centered healthcare to patient-centered healthcare. Fostering healthcare quality bridges the transition. Fragmented models were devised principally from the perspective of healthcare employees and professionals, including nurses and surgeons. The patient was primarily not integrated into this consideration, despite their pivotal role as the focus of care. The expectation is that the results of this study offer meaningful contributions and open up new research avenues in the area of practice in surgery.

A large body of literature has provided evidence-based strategies and policies for promoting interdisciplinary cooperation in healthcare settings among various domains. Until now, there has been a paucity of investigation in the literature on how nursing and pharmacy domains could join hands to ensure the delivery of

quality healthcare to patients seeking surgical operations. Collaboration and cooperation can proactively help resolve the core issues of surgery, pharmacy, and nursing to ensure superior healthcare provision in operating rooms. The viable integration of these two dominant domains in operating theaters is vital. Only then, as a consequence of such alignment, can profound healthcare quality in operating theaters be achieved and become a reality in healthcare settings. Interdisciplinary cooperation among professionals is necessary all the more so in the healthcare setting, given the fact that people's health and lives are at risk in these setups.

2. Importance of Collaboration Between Nursing and Pharmacy in Operating Rooms

Currently, emphasis has been placed on the importance of multidisciplinary collaboration (both intra-professional and interprofessional) in order to improve the quality of medical care. Among the many surgical processes, medication management is an example of interprofessional teamwork between nursing, pharmacy, and anesthesia. The conduct of surgical procedures demands high-quality teamwork. Nurses treat patients as a whole and provide various kinds of healthcare to them, whereas the medication prescriptions are all set by the attending physician. Meanwhile, pharmacists produce medications and provide guidance on which medications should be used. They also give information on the quantity of medications prescribed by the attending physician. The integrated expertise of nurses and pharmacists not only helps to prevent drug intervention at the time of surgery but also manages care capable of responding to various aspects directly linked to surgical procedures, in association with patients who planned and wanted surgical procedures. Cooperation between nurses and pharmacists, educational activities for staff by pharmacists, and guidance by pharmacists for selecting appropriate reagents at the time of emergency surgery in cooperation with clinical laboratory staff may help to minimize operational inefficiencies or mistakes occurring in other phases of laboratory examinations. This results in emergency relief of the state of illness. Moreover, rapid responses at the time of emergency surgeries may reduce patient anxiety about the disease and surgery and achieve not only surgery but also prompt recovery itself. It is also expected to lead to planning of medication administration and prohibition techniques, and the proper use of prophylactic antibiotics in the selected cases of surgeries that the pharmacist referred directly into the operating room. The integration of operating room management is effective in the medical safety aspect for the pharmacists, and it is also beneficial in the field of hospital management overall. (Porter & Lee, 2021)(Karunarathna et al.2024)(Zeb et al.2024)

3. Challenges Faced in Integrating Nursing and Pharmacy in Operating Rooms

The operating room is a complex environment with differing healthcare professionals. Collaboration between different expertise groups is crucial for successful patient outcomes. The most obvious difference is in the training of nurses, an increasing number of whom are university educated, and pharmacists, who require a high school background and a six-year university degree. The scope of practice and skill set of both groups differ widely, adding to the complexity of seamless integration. In a broad overview, the challenges that arise from not integrating nursing and pharmacy in the operating room involve communication, a lack of resources, regulation for the training of nurses and pharmacists, a lack of medication information and processes for changes, the belief that each does not

add to the care of the patient, and finally, patient safety risks of adverse drug events and medication errors; the primary goal of this paper.

One of the most common complexities when integrating differing knowledge bases often lies in the unawareness of specific professional terms. Vague or non-existent definitions of which unit order sent or IV or tubing used are prone to lead to miscommunication, which could result in the wrong medication being given to the patient. Furthermore, the refusal to accept the current procedure for ordering is predominantly related to an aspect of not knowing the medication order process. Each profession in the past relied on the other to undertake ordering and therefore was not concerned about how these orders came about. When asked by operating room managers why they just do it themselves, instead of the apparent dissatisfaction, the comment received was that of an unsure, "Can I do that?" There is a lack of knowledge between the two professions on how orders are to be taken, and where to access medication information; a larger perspective on ensuring seamless integration is required. In current practice, nurses and pharmacists are both eligible to view orders, with the nurse reordering stocks directly from traveling drugs that come from pharmacy. Further complications of price variances between hospitals, blood grab systems, and lack of guidelines for preparing drugs in the operating room that need to be considered in increasing hospital integration to create "new" ways of care.

A shift in the workforce is diluting some of the training initiatives being implemented. The nurse training program is a four-year degree, with a three-year direct entry in addition to one year of postgraduate entry with a steeper learning curve. Unfortunately, denial of the intensity of this training has refused to be accepted, particularly in hospitals with more traditional staff. To completely address all aspects of training required for both using combined skills and understanding the issues, a multimodal approach is required. Although in this instance the profession of psychologist/pharmacy educator was one and the same, a combination of material from both professions was needed and can be replicated individually. And finally, education of perioperative nurses and pharmacists when they enter the department on patient safety issues is essential.

3.1. Communication Barriers

Communication barriers between nursing and pharmacy in clinical settings are a significant issue. Different jargon, terminology, and language used between different disciplines can lead to confusion, misunderstandings, and ultimately medication errors. Furthermore, differences between professions in hierarchy, scope of practice, and organizational culture can impact effective communication. Clear and regular communication between all healthcare professionals is crucial to ensure safe, quality patient care. How nurses and pharmacists communicate and how issues impact surgical settings will be discussed in this section of the paper. It should be noted that healthcare is delivered in multi-disciplinary teams. Nursing and pharmacy are named in this paper as an example of poor communication between two professional groups. This is not meant to negate other professional groups from experiencing similar issues and is not intended to focus solely on just nursing and pharmacy multidisciplinary practices. (Filmer et al.2023)(Garin et al.2021)(Kim and Oh2020)

Miscommunication and communication breakdown pose severe risks to patient safety, particularly in operating rooms. The three most common sources of communication failure were: failing to adhere to a culture of safety and to establish a supportive, yet assertive team culture of doers, challenging assumptions in a way that can be done constructively, and working in an intense work environment for long hours. These communication issues resulted in a wide range of unintended medical outcomes such as major injury or death, delay in care or treatment, increase in symptoms, functional loss, and quality of life loss, lengthening of a hospital stay by at least 48 hours, and other signs of patient distress, discomfort, or dissatisfaction. Miscommunication between professions providing care for patients may also result in unnecessary anxiety for patients as well as their families, unnecessary reassessment by professional staff members, confusion, and an increase in unexpected admissions to wards after operations. Incorporating a culture in which open dialogue is encouraged promotes a positive environment of trust, being valued, and support, which in turn can influence the working relationships of both nurses and pharmacists, both inside and outside operating theatres. It is imperative for professional working relationships in a multidisciplinary team setting that open and transparent communication exists. Open dialogue fosters trust and promotes the belief that individuals are valued, supported, and part of a working environment that is considerate and caring. When communication barriers are eliminated, nurses and pharmacists alike are provided with the belief that the face-to-face interaction they have can also be transferred to their working relationships.

3.2. Differences in Training and Scope of Practice

Differences in Training and Scope of Practice. In North America, nursing education is delivered by colleges or universities, primarily at the bachelor's degree level. International variability in training exists, with entry to practice ranging from the associate's degree to the master's degree for registered nurse practice. Training for registered nurses in perioperative practice is obtained via post-diploma programs, on-the-job training, or as part of a medical/surgical program at the master's degree level. Post-graduate surgical nursing certificates are available in a variety of institutions as a mechanism to educate nurses willing to practice in perioperative settings. All nurses must complete a national exam or an exam to become a registered nurse in any Canadian province or American state. In this manuscript, the scope of nursing practice is based on the standards of practice, policy, and position statement provided by the Canadian Nurses Association.

Pharmacy education comprises several pathways in both the critical and non-critical care areas and is delivered by major universities within North America. The training includes an undergraduate focus on medication management, physiology, and social determinants of health. Health care professionals are trained to work in a discipline-specific silo, where collaborative practice is taught based on the roles and responsibilities of the individual perspective, neglecting the scope of practice for other health care providers. The increased complexity of healthcare in Canada and the focus on collaborative care has led to an escalation of interprofessional education for post-secondary institutions. This has resulted in different 'pockets' of skills whereby overlap in collaborative practice competencies can exist. Personnel who cross over into perioperative practice are often those with an interest in the area. Examples include students from nursing who take electives in pharmacy or

medical students who work in surgical teams for summer employment. (Al-Worafi, 2022)(Shrestha et al.2020)(Purwanto, 2020)

3.3. Medication Errors and Adverse Events

3.3. Medication errors and adverse events

Prevalence of medication errors and adverse events has been cited as an additional outcome of inadequate integration among healthcare professionals since lack of effective communication across units and inadequate interprofessional collaboration correlate with error rates, safety issues, and adverse drug events. Stressing the need for close integration and interprofessional collaboration, we found that more than 15% of nursing activities during anesthesia and surgery entail "checks and balances" to avoid possible medication misadministrations; loss of balance brings the medication errors ratio to 5.4%. Consequently, uncoordinated and fragmented systems are associated with an increased risk of medication error and care-related injury or incident, with a 66% higher likelihood during anesthesia and surgery. Both environmental and occupational stress factors have been postulated as drivers of medication errors and other incidents; however, close risk checks not only strengthen safety and care quality, but most importantly are preventive of different kinds of adverse outcomes for surgical patients, thus critically interfering with the recovery process. (Al et al.2021)(Alhur et al.2024)(Labrague et al.2022)(Almanna et al.undefined)(Kuppadakkath et al.2023)

If medication errors can result in a threefold jump in the probability of unscheduled admissions to the PACU or day surgery units, on top of a respective four- and eight-time higher likelihood of recurrent hypoxia and bronchospasm in spite of the related potential complications, it becomes clear that the degree of interaction, balance, and risk control of a nursing-pharmacy model provide an actual safety indicator during the critical phases of anesthesia and surgery. Adverse events have a significant detrimental effect on patients' anesthesiologists' perceptions and satisfaction about quality of care and safety in anesthesia, thus identifying the need for rigorous and methodical models of care to reduce the chances of such error rates. Medication errors decreased fivefold and the feasibility of introducing a nonclassifiable to a minor major prescription change jumped from 25% to 85% when nurses, as part of an integrated multidisciplinary team, undertook a daily medication reconciliation service; the service was associated with 318 significant identified and assessed discharge prescription errors in a year. In order to ensure better medication safety, it becomes imperative to have in place a pharmacocell therapeusis along the entire peri-anesthetic-surgical process. In so doing, practical guidance has been put forward to enable the combined expertise of nurses and pharmacists to provide reliable checks and balances conducive to the maintenance of quality in practice and patient safety. Integrated care and comprehensive and widely accepted professional standards have been established across the anesthesia, intensive care, peri-anesthetic, and surgical field.

4. Innovative Solutions for Enhancing Collaboration Between Nursing and Pharmacy

Several innovative solutions have been proposed to address the challenges of teamwork, communication, and error reduction in the operating room. In working collaboratively,

nurses and pharmacists can participate in interprofessional education with the healthcare team using a variety of models. These models are designed to promote the use of team-building exercises and teamwork simulation activities, where each team member's discipline is designated for specific role-playing instances that are meant to be common in interactions with other healthcare team members. This, in turn, is meant to assist each member of the team in developing and enhancing mutual respect for one another and an understanding of the role that each plays within the operating room or any other healthcare specialty. Cross-training, the practice of allowing operating room nurses and pharmacists to attend conferences and observe procedures that are not routine in the operating room, can better prepare the operating room team for changes.

Standardization of care and development of standardized protocols for communicating preferred practices among healthcare professionals have been suggested for years as a way of reducing variability and errors. Protocols such as the Universal Protocol seek to standardize the processes through which information regarding a patient's identification, correct procedure, and correct surgical site is verified before the incision is made. Shared decision-making processes are also being used to allow patients and families to be involved in these processes. Electronic health records that interface between the pharmacy and medical, nursing, healthcare team, anesthesia providers, and business managers are being developed. The healthcare professional team uses these electronic health records, allowing intraprofessional communication to occur between prescriber and pharmacist, then between pharmacy and the rest of the interprofessional healthcare team. Coordinating the medication process during skilled nursing care and engaging nurses, nursing assistants, pharmacists, and patients, as well as family members and other informal caregivers, in medication management plans can potentially improve patient safety. (Darwich et al.2021)(Prenosil et al.2022)

4.1. Interprofessional Education and Training Programs

The importance of formal interprofessional education (IPE) programs and training opportunities as a source of major input for building teamwork and collaboration is widely recognized. There are many different models to provide shared learning and to support mutual achievements in the education of healthcare professionals as they learn the roles, responsibilities, and qualities of all professionals in the healthcare team. The conceptual theoretical framework and a pedagogical approach to guide the design of the IPE programs for nursing and pharmacy students highlight that understanding and respect for the professions' expertise and for both their differing and shared conceptual and professional spaces need to be a significant priority. Planning your courses with shared and constructive relationships between the relevant institutes is key to providing a high-impact partnership. Participants in IPE programs have repeated gains in several desired competence areas and outcomes. The training tends to improve a range of competencies and outcomes in safety skills. The most anticipated improvement among the participants in these invaluable educational activities is in the domain of improved communication and teamwork effectiveness. Case studies from a few countries that address perioperative practices exemplify the contributions of IPE and training on key interprofessional communication and teamwork skills. More broadly, continuing on with the important components of this special issue, IPE synergy for perioperative care coursework is forward-thinking, proactive, cost-effective, and may provide high yields in personnel satisfaction and

accountability for healthcare system effectiveness and responsiveness to local community and population health needs. Healthcare microsystems, including operating rooms, need to be enhanced through continuous IPE. Although there are expenses around the implementation of IPE, it is argued that their long-term economic benefits will far outweigh cost burdens. Funding and the receipt of sponsorships for IPE programs and training from governmental and private sector partners are sound and strategic approaches for healthcare practice collaborations in healthcare education, including perioperative care. The many advantages of educational initiatives for perioperative care will help to emphasize the importance of learning and working with each other in order to build a more robust and progressive perioperative healthcare system. In summary, for the next generation of healthcare, 'interoperability' needs to be followed through personal integrity and actuality by a continuum of interprofessional education, training, and culturally competent healthcare practice. Appreciating the role education plays in the betterment of healthcare is central to a sustainable approach to interprofessional relationships. (Keshmiri & Barghi, 2021)(Ho et al.2023)(van Diggele et al., 2020)(Utley et al., 2020)(Shrader et al.2022)

4.2. Standardized Communication Protocols

A fundamental component of integration between nursing and pharmacy is the establishment of standardized communication protocols. Structured communication can prevent misunderstandings due to the differences in terminologies commonly used by nurses versus pharmacists. Misunderstandings regarding the various phases in medication management implemented by these two professions remain a primary cause of the need for improved teamwork within the perioperative process. The transfer of clear, concise, and crucial information during periods of increased patient vulnerability, such as when undergoing surgical interventions in an operating room, is essential to ensure patient safety. (Rawlinson et al.2021)(Sirimsi et al.2022)(Dabliz et al.2021)(Mohiuddin, 2020)(Ajegbile et al.2024)

Several models for standardized communication exist. In handoffs, SBARQ is mainly used. Established guidelines on perioperative communication include the Safe Surgery Checklist and the preoperative anesthesia evaluation performed according to established guidelines. In the context of communication with pharmacy, a successful pharmacist-nurse-managed pharmacy-integrated perioperative program was developed that included the development of protocols for handling home medications. This program aligns with the principles of ideal perioperative medication management and can be maintained as an integral program within the preoperative surgical home model of best practice as it demonstrates multispecialty cooperation and maintains the patient as the central member of the perioperative team. The surgical services chair worked with nurses and pharmacists over several months to revise, edit, and pilot a standardized hand-off form specific to our sociodemographic population, patient medications, wellness check procedures, and smoking screen requirements. Staff training on conducting the hand-off also occurred. (Kanter et al.2024)(Naseralallah et al.2024)

In order to assure adherence to these new processes, nurse managers were tasked with intermittent chart reviews to ensure policy compliance and maintenance of data by nursing

administration. Interprofessional collaboration was significantly enhanced by having a nurse and pharmacist dedicated to transitioning preoperative care. A pilot program found that structured documentation led to zero incidences of 'near misses' of patients who were noncompliant with regard to fasting times. A pilot program was launched to ease the transition to the new model and identify any issues that arose. Nurses reported improved time management and increased satisfaction by having dedicated personnel available. Feedback from nurses and pharmacists was generally positive. (Osewa, 2024)(Butterfoss et al.2022)(Alqarny et al.2024)(Naseralallah et al.2024)(Patel et al.2020)

4.3. Technological Solutions

4.3. Technological Solutions

One of the most effective tools to help nursing and pharmacy maintain close interaction is an integrated intra- and interoperative electronic health record. Such a tool can be used to order and document medications, collaborate over dosage adjustments and lab work, track the timing and training on antibiotic infusions, and assist anesthesia in following patient vital signs before, during, and after anesthesia. Even something as simple as digitally documenting when medications are given can help avoid dangerous drug information gaps. Others have advocated the use of digital communication platforms that directly connect the operating room and the central pharmacy to discuss in real time any discrepancies or additional information necessary. Similarly, having a dedicated “pharmacy OR resident” who is trained to function in both roles can help reinforce communication and documentation gaps. Telehealth platforms and mobile applications are slowly being adopted in other health systems to facilitate just-in-time access to anesthetic consultation from pharmacy. These programs are also piloting the use of structured validation tools to enhance telehealth training and adoption and test their effectiveness in heightening consultation processes. A key aspect of any technological development, however, is “change management,” or training members of nursing and pharmacy on how and when to use a novel tool. Without this, the digital solution will become the next abandoned stopgap integration tool. Health systems also face significant barriers to this approach, including privacy concerns of nonsecure communication platforms and the limits of a digitized medication management process. (Ren et al.2022)(Bignell & Petrovskaya, 2024)

In addition to the technological advances, nursing and pharmacy can also use mobile applications that can be used to educate their respective trainees on the crucial information in the joint protocol. However, this tool requires buy-in from the intermediate caretaker; the anesthesiologists must see this tool as functional and safe, and agree to use it to get these best practice recommendations to the attending PA or APRN. This app, in conjunction with face-to-face communication between pharmacy and nursing, should be an effective educational tool that will be portable from job to job, institution to institution. Integrated workflow is the path to successful integration. This kind of seamless integration lowers the statistical anomaly of communication drops. There are many reasons why nurses and their pharmacy colleagues may not communicate more frequently in person, even when both are in the same physical location: opportunities to communicate do not present themselves, both parties involved are too busy and do not have time for a face-to-face meeting, or one or both parties need to get more information before a meaningful face-to-face dialogue can take place. Inefficiency can have other causes. Perhaps the individuals

involved are locally segregated from one another or do not have a safe and efficient mechanism to cross the workspace and interact with others involved in patient care because they would have to gown up to enter a terminal clean room just to communicate with nursing colleagues in the anesthetizing location. Research has shown that low levels of communication between ICU CAH PAs and nursing colleagues are due to the fact that the CAH PAs' offices are on a separate floor. In all affected cases, a technology solution that is seamless in the context of the workflow pattern of the interprofessionals involved will bridge the communication gap and correct the action needed in the workflow. In so doing, technology can enhance on-the-fly action taking and patient care quality. (Godfrey, 2023)(Veenema et al.2021)(Nickel et al.2024)(Gutierrez et al.2021)(MCKENZIE and DAVIS2021)

5. Case Studies and Best Practices

This collection of case studies and best practices provides real-life tangible experience with the integration of nursing and pharmacy. Each case study provides a detailed account of integration challenges and successful solutions based on specific practice locations. The first case study, in an academic medical center, describes individual and collective education and process changes that promoted teamwork and better outcomes in sterile preparation and administration of intravenous medications. A second case study of specially trained oncology and cellular therapy pharmacy and nursing combines separate yet similar findings from the two practice situations. The operational and compliance loss in a hospital-based sterile product outsourcing facility is outlined with an emphasis on common problems faced, as well as an integrated solution, in collaboration with the facility's client hospitals to build for sustainable quality. A fourth study details the exceptional results at a free-standing pediatrics hospital with separating responsibilities and building interdisciplinary health systems compliance in chemotherapy mixing as a novel method of ensuring high-quality compounding. Finally, a regional comparison provides an additional dimension to delineate collaboration on this idea in different locations and systems. (Nurnaningsih et al.2024)

The diversity of locations and pharmacy responsibilities among this body of work makes a strong case for the use of this collection of case studies as a best practice tool. Each case provides information and suggestions for integral factors that contributed to a successful integration. A common thread throughout all of these case studies is the emphasis on continuous evaluation to ensure safe and effective services. The emphasis on this reveals a dedication to ongoing service improvement that has a positive impact on patient safety and satisfaction. The cases in this collection represent a snapshot of some areas of practice in which pharmacists and nurses can work together to transform healthcare. They underline not only the value of equipment, resources, and training but especially the importance of a strong relationship between nursing and pharmacy personnel. (Yoshida et al.2024)(Snoswell et al.2022)(Schwingrouber et al.2024)(Gemmeke et al.2022)(Fernandes et al.2022)(Sim et al., 2020)(Lech et al.2020)

6. Conclusion and Future Directions

In conclusion, this manuscript addresses key considerations of integrating the nursing and pharmacy professions within operating room (OR) settings to further advance and enhance the culture of safety and care in light of administration, practice, and policy. The landscape is evolving, as is the provision of high-quality surgical practices. Surgery has become dynamic and multifaceted in light of technologies, politics, finance, need, access, research, and consumer and patient expectations. More is needed to align stakeholders and enhance teamwork to address the complex risk exposures associated with surgical care. We can and must do better to act in concert.

A number of conceptual and practical barriers to developing innovative arrangements have been highlighted. For example, the contradiction at the heart of considering the business case for change considers the primacy of cost restraints when the question is really about how and why we are in business. The challenge is to recognize those long-held certainties while managing variation in deeply embedded social, institutional, and economic arrangements. We hope the considerations advanced in this document challenge those with a long investment to explore the future. The untapped potential of those who act as 'integrators' already between clinic, academia, practice, industry, and policy might be somewhat set free in the future.

While the 'team' metaphor for integrated working has been challenged, the processes of teamwork are sustained by institutional work, including educating the team players of the future. This means attention not only to recruitment and retention but also to changing workforce roles. Efforts to market integrated practice are unlikely to succeed in the absence of actual ongoing training and education. Understanding curricular and education changes required across the symbiotic workforce will be needed at undergraduate, graduate, and professional levels to reshape the institutional landscape, including amplified clinical simulation requirements. The importance of integrating pedagogic practice into institutional work as a matter of agency is evident. Crises do not necessarily lead to major change, but when a receptive environment allows, dramatic changes are made through reanimating existing craft, practices, and values.

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