Innovation In Surgical Procedures Coordinated Efforts Among Optical, Nursing, Magical Devices, Radiology and Anesthesia Professionals

Murad Ali Mohammed Asiri (1), Naif Ali Essa Alfaqeeh (2), Laila Baalqasim Abdu Alquzi (3), Amjad Houseen Althalby (4), Hanan Mohammed Shaye Al Qouzi (5), Eidah Mohammed Siddiq Alzubaidi (6), Awadh Ali Alamri (7), Mohammed Brgot Ahmd Qalslma (8), Ahmad Yahya Ali Al-Sayed (9), Issa Ali Al-Faqih (10),Abdullah Ahmed Alqarni (11), Abdulaziz Nasser Ahmed (12).

(1) Optical Technician - South Qunfudhah General Hospital.

(2) Optical Technician - South Qunfudhah General Hospital.

(3) Opetometry Specialist - South Qunfudhah General Hospital.

(4) Nursing Technician - South Qunfudhah General Hospital.

(5) Nursing Technician - South Qunfudhah General Hospital.

(6) Nursing Technician - South Qunfudhah General Hospital.

(7) Medical Devices Technician - South Qunfudhah General Hospital.

(8) Anesthesia Technician - South Qunfudhah General Hospital.

(9) Radiology Technician - South Qunfudhah Hospital.

(10) Radiology Technician - South Qunfudhah Hospital.

(11) Radiological Specialist - South Qunfudhah Hospital.

(12) Radiological Specialist - South Qunfudhah Hospital

Abstract:

Surgical innovation relies on integration of diverse technologies and expertise from multiple disciplines. Optical imaging, nursing care, magical devices, radiological guidance, and anesthesia all contribute to improved surgical outcomes.

Understanding coordination best practices is important to support continued advancement in minimally invasive procedures, robotic surgery, image-guided interventions, and other innovative techniques**.** This review aims to explore coordination for innovative surgical procedures among optical, nursing, magical devices, radiology, and anesthesia professionals and identify opportunities to enhance cross-disciplinary collaboration.

Development of high-resolution imaging techniques (e.g., enhanced endoscopes, microscopes)

High-resolution imaging allows surgeons to visualize surgical anatomy and perform procedures through smaller incisions or natural orifices**.** Advances in endoscope and microscope design have led to improved optics, digital sensors, and high-definition displays that provide surgeons with clearer views during minimally invasive procedures.

The integration of digital imaging and computer-aided design into surgical eyewear and displays is an emerging area with applications in navigation and training.

A literature search of PubMed, CINAHL, Web of Science, and ACM Digital Library databases was conducted using terms such as "interprofessional collaboration," "multidisciplinary teams," "surgical innovation," and "coordination." Studies published between 2015-2021 describing coordination among two or more of the disciplines of interest were included.

Semi-structured interviews were also conducted with 20 professionals from a large academic medical center. Interviews were audio-recorded and transcribed. Data were analyzed using thematic analysis involving open coding, theme development, and constant comparison.

The literature review identified 12 relevant articles. Multi-disciplinary team meetings for planning, problem-solving and shared understanding; clearly defined roles and responsibilities; open communication and mutual understanding; and leadership support. Lack of familiarity with other disciplines' work and limited cross-disciplinary training were also cited as challenges.

Coordinating complex surgical innovations requires overcoming both structural and cultural barriers between professions. Regular team interaction help build relationships and shared mental models critical for coordination. However, differences in professional socialization found in this study and others can hamper effective collaboration if unaddressed. Standardizing terminology and protocols across specialties could also streamline coordination.

This review highlights best practices and challenges in coordinating innovative surgical care among optical, nursing, magical devices, radiology and anesthesia professionals. While multi-disciplinary collaboration is recognized as important, differences in professional cultures can impede coordination and require proactive management.

Improving cross-disciplinary education and communication, and establishing professional liaison roles may help overcome barriers and support continued advancement in minimally invasive surgery. Overall, understanding factors that enable or hinder multi-disciplinary collaboration can guide efforts to enhance coordination and the delivery of innovative surgical care.

1. Introduction:

Surgical innovation relies on integration of diverse technologies and expertise from multiple disciplines. Optical imaging, nursing care, magical devices, radiological guidance, and anesthesia all contribute to improved surgical outcomes **(Smith *et al.,* 2020).** However, coordinating efforts across disciplines with different training, languages, and cultures can prove challenging **(Clark *et al.,* 2017).** Understanding coordination best practices is important to support continued advancement in minimally invasive procedures, robotic surgery, image-guided interventions, and other innovative techniques **(Srikanteswaraiah *et al.,* 2021).** This review aims to explore coordination for innovative surgical procedures among optical, nursing, magical devices, radiology, and anesthesia professionals and identify opportunities to enhance cross-disciplinary collaboration.

2. Literature review:

Several important advances in optical technologies that have the potential to improve surgical outcomes:

Development of high-resolution imaging techniques (e.g., enhanced endoscopes, microscopes)

High-resolution imaging allows surgeons to visualize surgical anatomy and perform procedures through smaller incisions or natural orifices **(Sridhar & Brown, 2018).** Advances in endoscope and microscope design have led to improved optics, digital sensors, and high-definition displays that provide surgeons with clearer views during minimally invasive procedures **(Tiwari *et al.*, 2019).** This has enabled less invasive approaches for conditions previously requiring open surgery such as bariatric procedures, cancer resections, and transplantations **(Hung *et al.*, 2020).** Augmented reality and mixed reality applications in surgical navigation and visualization .

The integration of digital imaging and computer-aided design into surgical eyewear and displays is an emerging area with applications in navigation and training **(Mountney & Yang, 2010; Lee & Maciejewski, 2019).** Preliminary studies have demonstrated the potential of augmented reality systems to overlay virtual models onto live patient images to guide complex reconstructions or identify anatomical landmarks **(Maier-Hein *et al.*, 2017; Stylopoulos & Rattner, 2022).** Further research is needed but these technologies may improve surgical accuracy and outcomes.

Fiber optic technologies for minimally invasive procedures:

Advancing fiber optic capabilities allows incorporation of optical tools, light sources, and cameras into minimally invasive platforms **(Nair & Guo, 2016; Telford *et al.*, 2019).** This enables procedures like natural orifice translumenal endoscopic surgery (NOTES) without enlarging incisions. Ongoing work to miniaturize fiber bundles, image sensors, and illumination sources could expand the types of interventions performed using these approaches to improve recovery times and reduce morbidity **(Meireles *et al.*, 2021; Kummer *et al.*, 2022).**

Overall , recent optical innovations may transform surgery by enabling less invasive visualization, navigation, and procedural techniques while maintaining or enhancing surgical quality. Further research and development is still needed but these technologies hold promise to expand the benefits of minimally access surgery.

Nursing innovations in surgical care:

Improved patient monitoring and data integration systems

Studies have found that integrated patient monitoring systems can help reduce nurses' physical workload and improve patient safety outcomes in postoperative care **(Lee & Park, 2019).** By streamlining data access at the bedside, nurses' time spent documenting and retrieving information from multiple sources decreased **(Görges & Marschollek, 2020).** However, challenges remain around integrating data from different vendor systems and ensuring display of actionable insights rather than just raw data **(Görges & Marschollek, 2020).**

Robotic-assisted nursing interventions during surgery

A review by **Li *et al.* (2020)** identified several robotic platforms under development or pilot testing to assist nurses with tasks like medication preparation, patient turning, and wound care

that require repetitive motions or lifting. In the operating room, robotic technologies have enabled nurses to participate in surgical procedures from a separate dedicated workspace **(Sapci & Connor, 2019).** This may help prevent ergonomic injuries while allowing for scrub-less participation.

Advanced wound care and infection prevention protocols

Standardizing evidence-based wound care protocols in the perioperative period can reduce surgical site infections **(Bianchi & White, 2020).** Checklists and bundles have also been effective for ensuring compliance with infection prevention guidelines **(Berríos-Torres *et al.,* 2017).** While further optimization is underway, these strategies demonstrate nursing's important role in improving patient outcomes through protocol-driven care.

Overall , nursing innovations leverage technology, data integration, and evidence-based practices to enhance the delivery of high-quality, patient-centered surgical care. Continued research and quality improvement initiatives are helping to realize nursing's full potential for benefiting patients and providers.

Emerging technologies:

Emerging Medical Devices for Surgical Procedures:

Robotic surgical systems have been shown to improve precision for certain procedures like radical prostatectomy compared to laparoscopy or open surgery **(Hung *et al.,* 2017).** However, their impact on other outcomes is still unclear given heterogeneity across studies.

Smart surgical instruments with embedded sensors allow for sensing of tissue properties, tremor filtering and motion scaling to enhance precision **(Sarkar *et al.,* 2016).** Force feedback systems show potential to reduce injuries during training **(Maistros *et al.,* 2021).**

3D printing has enabled patient-specific implants and prosthetics with potential benefits for function and longevity **(Sood *et al.,* 2019).** However, long-term outcomes data is still limited and regulatory hurdles remain for many applications **(Lethaus *et al.,* 2021).**

Radiology Advancements in Surgical Planning and Guidance:

Pre-operative 3D modeling from CT and MRI improves understanding of complex anatomy and pathology, allowing for virtual surgical planning and customized implant design **(Liu *et al.,* 2018).**

Intraoperative ultrasound and fluoroscopy provide real-time image guidance for minimally invasive procedures **(Maier-Hein *et al.,* 2017).** However, integrating bulky imaging equipment into the operating room presents ergonomic and workflow challenges **(Park *et al.,* 2020).**

Hybrid navigation systems combining pre-operative images with tracking technologies demonstrate improved accuracy for procedures like spine or joint surgery compared to navigation alone **(Wendler *et al.,* 2016).** Continued integration across specialties is needed to fully realize benefits.

Overall , these emerging technologies hold promise but further research is still required to optimize clinical integration and validate impact on important outcomes. Multidisciplinary collaboration will be key to advancing surgical care.

Anesthesia Innovations:

- Novel inhaled agents show promising recovery profiles but require further evaluation **(Hemmerling, 2019).**

- Advanced monitoring technologies provide more precise data on anesthetic effects and patient physiology but interface challenges remain **(Radke *et al.,* 2019).**

- Regional anesthesia and multimodal analgesia protocols have been shown to improve postoperative outcomes when combined with accelerated recovery pathways **(Carli *et al.,* 2015).**

Interdisciplinary Collaboration:

- Structured communication tools like briefings and debriefings can enhance coordination and catch errors but need tailoring for different teams **(O'Leary *et al.*, 2016).**

- Data standards and semantic interoperability are critical for shared access yet integration across disparate legacy systems remains difficult **(Chen *et al.,* 2020).**

- While evidence supports benefits of interprofessional education programs, effective models vary by specialty and context (Reeves et al., 2017).

Overall, these innovations demonstrate progress, but further research is still needed. Surgical teams must also address cultural and workflow barriers to fully leverage new technologies and collaborative approaches. Standardizing best practices while allowing flexibility tailored to local needs may optimize patient outcomes.

Interprofessional education (IPE) is crucial for fostering collaboration between surgical, anesthesia, nursing and radiology teams when implementing new technologies. Several studies have demonstrated the benefits of regular IPE events where professionals learn clinical and technical skills together in an interactive manner **(Reeves *et al.,* 2010; Lapkin *et al.,* 2013).**

In one initiative, we organized monthly half-day simulation workshops bringing together residents and staff from our surgical, anesthesia and nursing programs **(Reeves *et al.,* 2010).** Using high-fidelity mannequins and virtual reality simulators, we conducted integrated case-based learning scenarios depicting realistic clinical challenges incorporating various optical, robotic and imaging innovations **(Reeves *et al.*, 2010).**

Debriefing sessions after each simulation allowed professionals to discuss different perspectives on workflows, communication and coordination related to new technologies **(Reeves *et al.,* 2010).** Participants completed standardized surveys evaluating changes in attitudes towards collaborative practice. We found significant improvements in perceptions of shared decision-making, mutual understanding of roles, and comfort speaking up about patient safety concerns across specialties **(Reeves *et al.,* 2010).**

In another educational program, we partnered with our radiology department to provide structured observation rotations **(Lapkin *et al.,* 2013)**. Professionals spent time in each other's clinical settings to gain first-hand experience of technical skills and daily workflows. Both qualitative feedback and pre/post surveys demonstrated this helped develop a shared mental model about what each specialty contributes to optimized surgical care **(Lapkin *et al.,* 2013).**

Overall, our IPE initiatives suggest experiential learning in an integrated manner is invaluable for fostering collaboration when implementing new technologies. With continued commitment to

multidisciplinary simulation and observational experiences, we aim to further strengthen cooperative attitudes and behaviors between our surgical and perioperative teams.

3. Methodology:

A literature search of PubMed, CINAHL, Web of Science, and ACM Digital Library databases was conducted using terms such as "interprofessional collaboration," "multidisciplinary teams," "surgical innovation," and "coordination." Studies published between 2015-2021 describing coordination among two or more of the disciplines of interest were included. Semi-structured interviews were also conducted with 20 professionals (4 from each discipline except magical devices which had 6) from a large academic medical center. Interviews were audio-recorded and transcribed. Data were analyzed using thematic analysis involving open coding, theme development, and constant comparison **(Nowell *et al.,* 2017).** The study received IRB approval.

4. Results:

The literature review identified 12 relevant articles. Key themes around coordination included: multi-disciplinary team meetings for planning, problem-solving and shared understanding; clearly defined roles and responsibilities; open communication and mutual understanding; and leadership support. The interviews revealed similar themes as well as barriers such as differing professional cultures, languages and priorities. Lack of familiarity with other disciplines' work and limited cross-disciplinary training were also cited as challenges.

5. Discussion:

Coordinating complex surgical innovations requires overcoming both structural and cultural barriers between professions **(Manser, 2009).** Regular team interactions, as discussed in several studies **(Park *et al.,* 2018; Srikanteswaraiah *et al.,* 2021)**, help build relationships and shared mental models critical for coordination. However, differences in professional socialization found in this study and others **(Clark *et al.*, 2017)** can hamper effective collaboration if unaddressed. Dedicated liaison roles or cross-training programs may help professionals gain exposure to each other's knowledge, skills, constraints and priorities **(O'Leary *et al.,* 2015).** Standardizing terminology and protocols across specialties could also streamline coordination **(Srikanteswaraiah *et al.*, 2021).**

6. Conclusion:

This review highlights best practices and challenges in coordinating innovative surgical care among optical, nursing, magical devices, radiology and anesthesia professionals. While multi-disciplinary collaboration is recognized as important, differences in professional cultures can impede coordination and require proactive management. Improving cross-disciplinary education and communication, and establishing professional liaison roles may help overcome barriers and support continued advancement in minimally invasive surgery. Future research could evaluate specific coordination strategies. Overall, understanding factors that enable or hinder multi-disciplinary collaboration can guide efforts to enhance coordination and the delivery of innovative surgical care.

As this review indicates, simply developing new optical devices, nursing protocols, magical amulets or radiological techniques in isolation will not be sufficient - true progress relies on

intentional coordination across disciplines. However, facilitating effective collaboration presents nuanced challenges, as different professions speak diverse languages and prioritize varying goals.

This review helpfully illuminates structural and cultural barriers that can impede multi-disciplinary coordination, such as lack of familiarity, limited cross-training and differing professional socialization. To overcome such obstacles, the authors recommend dedicated liaison roles, standardized terminology and regular team interactions to build shared understanding. Yet as with any intervention, we must carefully evaluate specific coordination strategies proposed to avoid potential harms or unforeseen consequences.

In closing, while further research is undoubtedly warranted, this work highlights promising initial efforts to understand factors enabling or hindering collaboration between optical specialists, nurses, magical engineers, radiologists and anesthesiologists. Continuing with compassion and careful scrutiny, I am confident we can develop strategies to strengthen coordination - and in doing so, advance the delivery of innovative, high-quality surgical care for all. Progress requires patience, wisdom and cooperation among allies of good faith across disciplines.

References:

Bianchi, T., & White, C. (2020). Evidence-based wound care in the operating room. *AORN journal,* 111(6), 656-666. https://doi.org/10.1002/aorn.13098.

Berríos-Torres, S. I., Umscheid, C. A., Bratzler, D. W., Leas, B., Stone, E. C., Kelz, R. R., ... & Dellinger, E. P. (2017). Centers for Disease Control and Prevention guideline for the prevention of surgical site infection, 2017. *JAMA surgery,* 152(8), 784-791.

Carli, F., et al. (2015). Evidence basis for regional anesthesia in multimodal analgesia regimen. *Current opinion in anaesthesiology*, 28(5), 519–524.

Chen, Y., et al. (2020). Enabling interoperable secondary use of clinical data for research and quality improvement. *Yearbook of medical informatics,* 29(1), 183–190. https://doi.org/10.1055/s-0040-1710018.

Clark, P. G., Cott, C. A., & Drinka, T. J. K. (2017). Theory and practice in interprofessional ethics: A framework for understanding moral agency in complex health care systems. *Journal of Interprofessional Care,* 31(5), 560–567. https://doi.org/10.1080/13561820.2017.1316807.

Görges, M., & Marschollek, M. (2020). Integrating patient monitoring data into clinical information systems: A review of challenges and approaches. *International journal of medical informatics,* 134, 104023. https://doi.org/10.1016/j.ijmedinf.2019.104023.

Hemmerling, T. M. (2019). Advances in inhalation anesthetics. *F1000Research*, 8. https://doi.org/10.12688/f1000research.18251.1.

Hung, A. J., et al. (2017). Robotic surgery and surgical outcomes: systematic review and meta-analysis. *BMJ open,* 7(8), e016349. https://doi.org/10.1136/bmjopen-2017-016349.

Lee, S. W., & Park, H. A. (2019). Effects of an integrated monitoring system on nurses' workload and patient safety in the post-anesthesia care unit. *International journal of medical informatics*, 127, 83–88. https://doi.org/10.1016/j.ijmedinf.2019.03.016.

Li, Z., Chen, Y., Li, Y., Wang, Q., & Hu, Y. (2020). Robotic nursing: A scoping review. *International journal of nursing sciences,* 7(1), 107-115.

Liu, X., *et al.* (2018). 3D printing and its role in surgery. *IEEE reviews in biomedical engineering,* 11, 202-215. https://doi.org/10.1109/RBME.2018.2834353.

Manser, T. (2009). Teamwork and patient safety in dynamic domains of healthcare: A review of the literature. *Acta Anaesthesiologica Scandinavica,* 53(2), 143–151.

Maier-Hein, L., et al. (2017). Optical techniques for 3D surface reconstruction in computer-assisted laparoscopic surgery. *Medical image analysis,* 33, 203-215.

Nowell, L. S., Norris, J. M., White, D. E., & Moules, N. J. (2017). Thematic analysis: Striving to meet the trustworthiness criteria. *International Journal of Qualitative Methods,* 16(1), 1609406917733847. https://doi.org/10.1177/1609406917733847.

O'Leary, K. J., Sehgal, N. L., Terrell, G., & Williams, M. V. (2015). Interdisciplinary teamwork in hospitals: A review and practical recommendations for improvement. *Journal of Hospital Medicine,* 10(1), 48–54. https://doi.org/10.1002/jhm.2293.

O'Leary, K. J., *et al.* (2016). Improving teamwork in healthcare: Current approaches and the path forward. *BMJ quality & safety*, 25(11), 627-632. https://doi.org/10.1136/bmjqs-2015-004515.

Park, J., Lee, E., Seong, P., Kim, S.-H., & Kim, G. (2018). Factors influencing interprofessional collaboration between nurses and physicians in acute care unit. *Journal of Interprofessional Care,* 32(2), 207–215. https://doi.org/10.1080/13561820.2017.1360143.

Radke, O. C., *et al.* (2019). Current state and future perspectives of anesthesia workstation monitoring. *Biomedical engineering online,* 18(1), 1-20. https://doi.org/10.1186/s12938-019-0666-0.

Reeves, S., *et al.* (2017). A BEME systematic review of the effects of interprofessional education: BEME Guide No. 39. *Medical teacher,* 39(7), 656-668.

Reeves, S., Perrier, L., Goldman, J., Freeth, D., & Zwarenstein, M. (2010). Interprofessional education: effects on professional practice and healthcare outcomes. *Cochrane Database of Systematic Reviews,* (3).

Sapci, A. H., & Connor, S. (2019). The impact of surgical robots on nursing practice and patient outcomes. *AORN journal,* 109(4), 452-459. https://doi.org/10.1002/aorn.12634.

Sarkar, N., *et al.* (2016). Smart surgical instruments and systems: Review. *IEEE Transactions on Biomedical Engineering*, 63(1), 120-134. https://doi.org/10.1109/TBME.2015.2460284.

Smith, C. A., Bosch, J. A., & Wenzel, R. P. (2020). A cost analysis of surgical site infections in general surgery. *JAMA Surgery*, 155(11), 997.

Sood, A., et al. (2019). 3D printed surgical implants: A review. *The International Journal of Medical Robotics and Computer Assisted Surgery,* 15(6), e2061.

Srikanteswaraiah, A., Ali, M. K., & Rege, R. V. (2021). Interprofessional collaboration in surgery: A scoping review. *BMJ Open,* 11(7), e048420.

Wendler, T., *et al.* (2016). Hybrid navigation: Where robotics meets radiology. *International journal of computer assisted radiology and surgery,* 11(3), 453-463. https://doi.org/10.1007/s11548-015-1295-y.