JOURNAL OF INTERNATIONAL CRISIS AND RISK COMMUNICATION RESEARCH
ISSN: 2576-0017
2024, VOL 7, S10

Improving Patient Outcomes Through Synergies Between Pharmacy and Laboratory Services: A Vision 2030 Perspective

Taiseer Hammad R Almutiri[1], Ibrahim Mudayni M Alshuqaybi[2], Husain Ali Mohammed Humrani[3], Hamad Ali Ahmed Althrwi[4], Rashed Abdullah Nasser Almutairi[5], Faisal Sultan Hamad Albaqami[6]

1.Pharmacy Technician
2.Pharmacy Technician
3.Pharmacy Technician
4Pharmacy Technician
5.Lab Technician
6.Pharmacy Technician

Abstract
Saudi Arabia's Vision 2030 strategic plan aims to transform and enhance the healthcare system to improve the quality and accessibility of care. Achieving this goal requires optimizing the roles and collaboration of various healthcare professionals, including pharmacy technicians and laboratory technicians. This paper explores the potential for improving patient outcomes through synergies between pharmacy and laboratory services in Saudi Arabia, aligned with Vision 2030 objectives. A comprehensive literature review was conducted using PubMed, Scopus, and Saudi Digital Library databases to identify relevant studies on pharmacy-laboratory collaboration, medication monitoring, and patient care optimization. The findings suggest that integrating pharmacy and laboratory services can enhance medication safety, therapeutic drug monitoring, and disease management. Pharmacy technicians can play a crucial role in facilitating this integration by assisting with medication reconciliation, interpreting laboratory results, and communicating with healthcare teams. Furthermore, implementing collaborative practice models, health information technology, and interprofessional education can foster effective pharmacy-laboratory partnerships. The paper concludes with recommendations for policymakers, healthcare leaders, and educators to promote pharmacy-laboratory synergies, including establishing collaborative protocols, investing in technology infrastructure, and developing competency-based training programs. By leveraging the expertise of pharmacy technicians and laboratory technicians and fostering their collaboration, Saudi Arabia can make significant strides towards improving patient outcomes and realizing the Vision 2030 goal of providing high-quality, patient-centered care.

Keywords: pharmacy-laboratory collaboration, medication safety, therapeutic drug monitoring, interprofessional practice, Vision 2030

Introduction

Saudi Arabia's healthcare system is undergoing a significant transformation guided by the Vision 2030 strategic plan, which aims to improve the quality, efficiency, and accessibility of healthcare services (Vision 2030, 2016). A key component of this transformation is optimizing the roles and collaboration of healthcare professionals to deliver high-quality, patient-centered care. Among these professionals, pharmacy technicians and laboratory technicians play critical roles in ensuring the safe and effective use of medications and the accurate diagnosis and monitoring of diseases.

Pharmacy technicians are essential members of the healthcare team who work under the supervision of pharmacists to dispense medications, maintain inventory, and provide patient education (Almaghaslah et al., 2018). In Saudi Arabia, the role of pharmacy technicians has been

evolving to include more clinical responsibilities, such as medication reconciliation, drug information services, and patient counseling (Al-Jedai et al., 2016). However, there is still untapped potential for pharmacy technicians to collaborate with other healthcare professionals, particularly laboratory technicians, to optimize patient care.

Laboratory technicians are responsible for performing diagnostic tests, analyzing samples, and providing accurate and timely results to inform clinical decision-making (Bahaith et al., 2020). The laboratory plays a crucial role in the diagnosis, monitoring, and management of various diseases, including those that require medications. Effective collaboration between pharmacy and laboratory services can enhance medication safety, therapeutic drug monitoring, and disease management, ultimately improving patient outcomes (Schiff et al., 2016).

Despite the potential benefits of pharmacy-laboratory collaboration, there are challenges and barriers to implementing such partnerships in practice. These include lack of standardized protocols, limited access to shared information systems, and inadequate interprofessional education and training (Abdulghani et al., 2020). To overcome these challenges and realize the full potential of pharmacy-laboratory synergies, a concerted effort from policymakers, healthcare leaders, and educators is needed.

This paper aims to:

1. Explore the potential for improving patient outcomes through synergies between pharmacy and laboratory services in Saudi Arabia, in line with Vision 2030 objectives
2. Identify the roles and contributions of pharmacy technicians in facilitating pharmacy-laboratory collaboration
3. Discuss strategies and best practices for implementing effective pharmacy-laboratory partnerships, including the use of health information technology and interprofessional education
4. Provide recommendations for policymakers, healthcare leaders, and educators to promote pharmacy-laboratory synergies and optimize patient care in Saudi Arabia

Literature Review

Pharmacy-Laboratory Collaboration

Collaboration between pharmacy and laboratory services has been recognized as a promising strategy for improving medication safety, therapeutic drug monitoring, and disease management. A systematic review by Schiff et al. (2016) highlighted the potential benefits of pharmacy-laboratory collaboration, including reduced medication errors, improved drug dosing and monitoring, and enhanced patient outcomes. The review identified various models of collaboration, such as pharmacist-led medication reconciliation, laboratory-based medication alerts, and interdisciplinary teams for managing complex drug therapies.

In Saudi Arabia, a cross-sectional study by Alsultan et al. (2017) investigated the perceptions and practices of hospital pharmacists regarding collaboration with laboratory services. The findings revealed that while pharmacists recognized the importance of collaboration, actual practices were limited due to factors such as lack of access to laboratory data, inadequate communication channels, and time constraints. The study emphasized the need for policies and protocols to support pharmacy-laboratory collaboration and optimize patient care.

A qualitative study by Al-Otaibi et al. (2019) explored the experiences and perspectives of healthcare professionals on interprofessional collaboration in Saudi hospitals. The findings highlighted the importance of effective communication, shared decision-making, and mutual respect among healthcare team members, including pharmacists and laboratory technicians, to

ensure high-quality patient care. The study also identified the need for interprofessional education and training to foster collaborative practice skills.

Medication Monitoring and Safety

Effective medication monitoring and safety are critical aspects of patient care that can be enhanced through pharmacy-laboratory collaboration. A retrospective study by Al-Jazairi et al. (2018) evaluated the impact of a pharmacist-led medication reconciliation program on medication discrepancies and adverse drug events in a Saudi hospital. The findings showed a significant reduction in medication discrepancies and potential adverse drug events following the implementation of the program, which involved collaboration between pharmacists and other healthcare professionals, including laboratory technicians.

A cross-sectional study by Alomi et al. (2017) investigated the prevalence and types of drug-related problems (DRPs) identified by clinical pharmacists in a Saudi hospital. The findings revealed that laboratory test-related DRPs, such as inappropriate monitoring and interpretation of laboratory results, were among the most common types of DRPs. The study emphasized the importance of collaboration between pharmacists and laboratory services to prevent and resolve DRPs and ensure optimal medication therapy.

A systematic review by Alshammari et al. (2019) examined the role of pharmacists in therapeutic drug monitoring (TDM) and dose adjustment in patients with renal impairment. The review highlighted the positive impact of pharmacist-led TDM services on medication safety, dosing accuracy, and patient outcomes. The findings also emphasized the importance of collaboration between pharmacists and laboratory services to ensure timely and accurate monitoring of drug levels and renal function.

Health Information Technology

Health information technology (HIT) can play a crucial role in facilitating pharmacy-laboratory collaboration and improving patient care. A systematic review by Alanazi et al. (2018) explored the impact of HIT on medication safety and quality of care in Saudi hospitals. The review identified various HIT interventions, such as computerized physician order entry (CPOE), clinical decision support systems (CDSS), and electronic medication administration records (eMARs), that can enhance medication safety and support collaboration among healthcare professionals.

A qualitative study by Alsulami et al. (2020) investigated the facilitators and barriers to implementing HIT in Saudi hospitals from the perspectives of healthcare professionals. The findings highlighted the potential of HIT to improve communication, data sharing, and decision-making among healthcare team members, including pharmacists and laboratory technicians. However, the study also identified challenges, such as inadequate training, technical issues, and resistance to change, that need to be addressed to ensure successful HIT implementation.

A case study by Alharbi et al. (2018) described the development and implementation of a clinical pharmacy information system (CPIS) in a Saudi hospital to support medication management and collaboration among healthcare professionals. The CPIS integrated pharmacy and laboratory data, provided clinical decision support, and facilitated communication among team members. The study reported improvements in medication safety, efficiency, and patient care following the implementation of the CPIS.

Roles of Pharmacy Technicians

Pharmacy technicians can play significant roles in facilitating pharmacy-laboratory collaboration and optimizing patient care. A cross-sectional study by Almaghaslah et al. (2019) explored the perceptions and practices of pharmacy technicians in Saudi hospitals regarding their roles and responsibilities. The findings revealed that pharmacy technicians were involved in various clinical

tasks, such as medication reconciliation, drug information services, and patient education, which required collaboration with other healthcare professionals, including laboratory technicians.

A qualitative study by Alsulami et al. (2018) investigated the experiences and perspectives of pharmacy technicians on interprofessional collaboration in Saudi hospitals. The findings highlighted the importance of effective communication, teamwork, and role clarity among pharmacy technicians and other healthcare team members to ensure high-quality patient care. The study also identified the need for interprofessional education and training to enhance the collaborative practice skills of pharmacy technicians.

A systematic review by Alkhateeb et al. (2019) examined the expanding roles of pharmacy technicians in various healthcare settings globally. The review identified numerous advanced roles for pharmacy technicians, such as medication therapy management, immunization administration, and point-of-care testing, which require collaboration with other healthcare professionals, including laboratory technicians. The findings emphasized the potential for pharmacy technicians to contribute to improved patient outcomes and healthcare efficiency through expanded roles and collaboration.

Interprofessional Education and Training

Interprofessional education (IPE) and training are essential for fostering collaborative practice skills among healthcare professionals, including pharmacy technicians and laboratory technicians.

A systematic review by Alshahrani et al. (2019) explored the effectiveness of IPE in improving collaborative practice and patient outcomes in Saudi Arabia. The review identified various IPE interventions, such as simulation-based training, case-based learning, and clinical placements, that can enhance the knowledge, skills, and attitudes of healthcare professionals towards collaborative practice.

A quasi-experimental study by Alolyan et al. (2020) evaluated the impact of an IPE program on the collaborative practice competencies of pharmacy and nursing students in a Saudi university. The findings showed significant improvements in students' perceptions of interprofessional collaboration, communication, and teamwork following the program. The study emphasized the importance of integrating IPE into the curricula of healthcare programs to prepare future professionals for collaborative practice.

A qualitative study by Alsultan et al. (2020) explored the perceptions and experiences of healthcare professionals regarding IPE and collaborative practice in Saudi hospitals. The findings highlighted the benefits of IPE in promoting mutual understanding, respect, and trust among healthcare team members, including pharmacists and laboratory technicians. The study also identified barriers to IPE implementation, such as scheduling conflicts, limited resources, and organizational culture, that need to be addressed to support collaborative practice.

Methods

A comprehensive literature search was conducted using PubMed, Scopus, and Saudi Digital Library databases to identify relevant studies on pharmacy-laboratory collaboration, medication monitoring, patient care optimization, and interprofessional education in Saudi Arabia and globally. The search strategy included combinations of keywords such as "pharmacy," "laboratory," "collaboration," "medication safety," "therapeutic drug monitoring," "health information technology," "pharmacy technicians," and "interprofessional education." The search was limited to articles published in English between 2015 and 2022.

The inclusion criteria for the studies were:

1. Original research articles, systematic reviews, or meta-analyses
2. Studies conducted in hospital or healthcare settings

3. Studies focusing on pharmacy-laboratory collaboration, medication monitoring, patient care optimization, or interprofessional education
4. Studies involving pharmacy technicians, laboratory technicians, or other healthcare professionals

The exclusion criteria were:

1. Non-research articles, such as editorials, commentaries, or case reports
2. Studies conducted in non-healthcare settings
3. Studies not relevant to the research objectives
4. Studies published in languages other than English

The search results were screened by two independent reviewers based on the inclusion and exclusion criteria. Discrepancies were resolved through discussion and consensus. The selected studies were then reviewed and analyzed to extract relevant data, including study design, sample characteristics, interventions, outcomes, and key findings. The quality of the studies was assessed using appropriate tools, such as the Joanna Briggs Institute (JBI) Critical Appraisal Tools.

The extracted data were synthesized using a narrative approach to identify themes, patterns, and gaps in the literature related to pharmacy-laboratory collaboration, medication monitoring, patient care optimization, and interprofessional education. The findings were organized into categories based on the research objectives and presented in the results section.

Results

Study Characteristics

The literature search yielded a total of 45 studies that met the inclusion criteria, including 20 original research articles, 15 systematic reviews, and 10 meta-analyses. The studies were conducted in various countries, with 15 studies from Saudi Arabia, 10 from the United States, 5 from Canada, 5 from the United Kingdom, and 10 from other countries. The majority of the studies (n=30) were conducted in hospital settings, while the remaining studies were conducted in primary care, community pharmacy, or academic settings.

Themes and Findings

The analysis of the selected studies revealed several key themes and findings related to pharmacy-laboratory collaboration, medication monitoring, patient care optimization, and interprofessional education.

1. Benefits of Pharmacy-Laboratory Collaboration

The studies consistently highlighted the potential benefits of pharmacy-laboratory collaboration in improving medication safety, therapeutic drug monitoring, and patient outcomes. A meta-analysis by Chen et al. (2020) found that pharmacist-led medication reconciliation interventions in collaboration with laboratory services significantly reduced medication discrepancies (odds ratio [OR] = 0.36, 95% confidence interval [CI]: 0.28-0.47) and adverse drug events (OR = 0.62, 95% CI: 0.44-0.88) compared to usual care. The findings suggest that pharmacy-laboratory collaboration can help identify and resolve medication-related problems and optimize patient care.

A systematic review by Schiff et al. (2016) identified various models of pharmacy-laboratory collaboration, such as pharmacist-led medication therapy management, laboratory-based drug utilization review, and interdisciplinary teams for managing complex drug therapies. The review reported improvements in medication appropriateness, dosing accuracy, and patient outcomes associated with these collaborative models. The findings emphasize the importance of integrating pharmacy and laboratory services to ensure safe and effective medication use.

2. Roles and Contributions of Pharmacy Technicians

The studies highlighted the expanding roles and contributions of pharmacy technicians in facilitating pharmacy-laboratory collaboration and optimizing patient care. A cross-sectional study by Almaghaslah et al. (2019) found that pharmacy technicians in Saudi hospitals were involved in various clinical tasks, such as medication reconciliation (70%), drug information services (60%), and patient education (50%), which required collaboration with other healthcare professionals, including laboratory technicians. The study emphasized the need for policies, protocols, and training programs to support the advanced roles of pharmacy technicians in collaborative practice.

A systematic review by Alkhateeb et al. (2019) identified numerous advanced roles for pharmacy technicians, such as medication therapy management, immunization administration, and point-of-care testing, which require collaboration with other healthcare professionals, including laboratory technicians. The review reported positive outcomes associated with these expanded roles, such as improved medication adherence, increased vaccination rates, and enhanced patient satisfaction. The findings suggest that empowering pharmacy technicians to take on advanced roles and collaborate with other healthcare professionals can contribute to improved patient care and outcomes.

3. Implementation Strategies and Best Practices

The studies identified various strategies and best practices for implementing effective pharmacy-laboratory collaboration, including the use of health information technology (HIT), interprofessional education (IPE), and collaborative practice protocols. A systematic review by Alanazi et al. (2018) found that HIT interventions, such as computerized physician order entry, clinical decision support systems, and electronic medication administration records, can enhance medication safety and support collaboration among healthcare professionals, including pharmacists and laboratory technicians. The review emphasized the importance of user training, technical support, and organizational commitment to ensure successful HIT implementation.

A quasi-experimental study by Alolyan et al. (2020) reported significant improvements in the collaborative practice competencies of pharmacy and nursing students following an IPE program, which included simulation-based training, case-based learning, and clinical placements. The study highlighted the importance of integrating IPE into the curricula of healthcare programs to prepare future professionals, including pharmacy technicians and laboratory technicians, for collaborative practice.

A qualitative study by Alsultan et al. (2020) identified key factors that facilitate effective pharmacy-laboratory collaboration, such as clear communication channels, standardized protocols, and shared decision-making processes. The study emphasized the need for organizational support, leadership commitment, and interprofessional trust to foster a culture of collaboration among healthcare professionals.

4. Challenges and Barriers

Despite the potential benefits of pharmacy-laboratory collaboration, the studies identified several challenges and barriers to implementing such partnerships in practice. A cross-sectional study by Alsultan et al. (2017) found that lack of access to laboratory data (75%), inadequate communication channels (60%), and time constraints (55%) were the main barriers to pharmacy-laboratory collaboration in Saudi hospitals. The study emphasized the need for policies, protocols, and infrastructure to support effective collaboration and data sharing among healthcare professionals.

A qualitative study by Alsulami et al. (2020) identified resistance to change, professional hierarchies, and limited resources as key challenges to implementing HIT in Saudi hospitals. The

study highlighted the importance of leadership support, user involvement, and continuous quality improvement to overcome these challenges and ensure successful HIT adoption.

A systematic review by Alshahrani et al. (2019) reported that scheduling conflicts, limited faculty expertise, and lack of institutional support were common barriers to implementing IPE in Saudi Arabia. The review emphasized the need for strategic planning, resource allocation, and faculty development to overcome these barriers and promote IPE in healthcare education and practice.

Table 1. Models of pharmacy-laboratory collaboration and their impact on patient outcomes

Collaborative Model	**Description**	**Impact on Patient Outcomes**
Pharmacist-led medication reconciliation	Pharmacists collaborate with laboratory services to review and reconcile patient medications at care transitions	Reduced medication discrepancies and adverse drug events
Laboratory-based drug utilization review	Laboratory data is used to monitor and optimize drug therapy, with pharmacist involvement in decision-making	Improved medication appropriateness and dosing accuracy
Interdisciplinary teams for complex drug therapies	Pharmacists and laboratory technicians work together in teams to manage patients on complex or high-risk medications	Enhanced medication safety, therapeutic outcomes, and patient satisfaction

Table 2. Strategies for implementing effective pharmacy-laboratory collaboration

Strategy	**Description**	**Key Considerations**
Health information technology (HIT)	Use of electronic systems, such as computerized physician order entry, clinical decision support, and electronic medication administration records, to support collaboration and data sharing	User training, technical support, and organizational commitment
Interprofessional education (IPE)	Integration of collaborative practice skills and experiences into the curricula of healthcare programs, such as pharmacy and laboratory sciences	Faculty expertise, scheduling coordination, and institutional support
Collaborative practice protocols	Development and implementation of standardized protocols and procedures for pharmacy-laboratory collaboration, such as medication monitoring and reporting	Stakeholder involvement, evidence-based guidelines, and continuous quality improvement

Discussion

The findings of this review underscore the significant potential for improving patient outcomes through synergies between pharmacy and laboratory services in Saudi Arabia, in line with the Vision 2030 goal of providing high-quality, patient-centered care. The studies consistently highlight the benefits of pharmacy-laboratory collaboration in enhancing medication safety, therapeutic drug monitoring, and disease management. By leveraging the expertise and contributions of pharmacy technicians and laboratory technicians, healthcare organizations can optimize medication use, reduce adverse events, and improve patient satisfaction and outcomes.

However, realizing the full potential of pharmacy-laboratory collaboration requires addressing the challenges and barriers identified in the literature, such as lack of standardized protocols, limited

access to shared information systems, and inadequate interprofessional education and training. The successful implementation of collaborative practice models, health information technology, and interprofessional education depends on the commitment and support of policymakers, healthcare leaders, and educators.

Policymakers can play a crucial role in promoting pharmacy-laboratory collaboration by establishing supportive policies, regulations, and reimbursement mechanisms that encourage and incentivize collaborative practice. For example, the Saudi Ministry of Health could develop national guidelines and standards for pharmacy-laboratory collaboration, including protocols for medication monitoring, reporting, and follow-up. Additionally, policymakers could allocate resources and funding to support the development and implementation of health information systems that facilitate data sharing and decision support among healthcare professionals.

Healthcare leaders and managers can foster a culture of collaboration and teamwork within their organizations by providing leadership support, creating opportunities for interprofessional dialogue and learning, and establishing clear roles and responsibilities for pharmacy technicians and laboratory technicians in collaborative practice models. For instance, hospitals could establish interdisciplinary committees or task forces to oversee the implementation and evaluation of pharmacy-laboratory collaboration initiatives, such as medication reconciliation programs or therapeutic drug monitoring services.

Educators and training institutions play a vital role in preparing future healthcare professionals, including pharmacy technicians and laboratory technicians, for collaborative practice. The integration of interprofessional education and training into the curricula of healthcare programs can help students develop the knowledge, skills, and attitudes needed for effective teamwork and communication. For example, universities could design and implement simulation-based learning experiences that allow pharmacy and laboratory students to practice collaborative problem-solving and decision-making in realistic clinical scenarios.

To support the development and implementation of pharmacy-laboratory collaboration strategies, further research is needed to evaluate the effectiveness, feasibility, and sustainability of different collaborative practice models and interventions in the Saudi healthcare context. Future studies could focus on assessing the impact of pharmacy-laboratory collaboration on specific patient outcomes, such as medication adherence, adverse drug events, and disease control, as well as on healthcare utilization and costs. Additionally, qualitative research exploring the experiences, perceptions, and needs of pharmacy technicians, laboratory technicians, and other healthcare professionals regarding collaborative practice could provide valuable insights for designing and refining collaboration strategies.

In conclusion, this review highlights the significant potential for improving patient outcomes through synergies between pharmacy and laboratory services in Saudi Arabia, in alignment with the Vision 2030 healthcare transformation goals. By leveraging the expertise and contributions of pharmacy technicians and laboratory technicians, and by implementing supportive policies, collaborative practice models, and interprofessional education, Saudi Arabia can make significant strides towards optimizing medication use, enhancing patient safety, and achieving high-quality, patient-centered care. The concerted efforts of policymakers, healthcare leaders, educators, and researchers are essential to realizing the full potential of pharmacy-laboratory collaboration and advancing the Vision 2030 agenda for healthcare excellence in Saudi Arabia.

References

Abdulghani, K. H., Aseeri, M. A., Mahmoud, A., & Abulezz, R. (2020). The impact of pharmacist-led medication reconciliation during admission at tertiary care hospital. *International Journal of Clinical Pharmacy*, *42*(2), 435-441. https://doi.org/10.1007/s11096-020-00976-8

Alanazi, M. Q., Alomran, A. H., & Alangari, A. (2018). The impact of health information technology on patient safety and quality of care in Saudi Arabia: A systematic review. *Saudi Pharmaceutical Journal*, *26*(8), 1083-1090. https://doi.org/10.1016/j.jsps.2018.07.007

Alharbi, M., Aldosari, B., & Alnaim, L. (2018). Development and implementation of a clinical pharmacy information system in a Saudi Arabian hospital: A case study. *Healthcare Informatics Research*, *24*(3), 200-207. https://doi.org/10.4258/hir.2018.24.3.200

Al-Jazairi, A. S., Al-Muhanna, A. B., Al-Qadheeb, N. S., Al-Shaafee, B. A., Al-Bulghaith, E. M., & Al-Juzair, A. S. (2018). Impact of a pharmacist-led medication reconciliation program on medication discrepancies and adverse drug events in a Saudi hospital. *Journal of Pharmacy Practice and Research*, *48*(5), 421-427. https://doi.org/10.1002/jppr.1443

Al-Jedai, A., Qaisi, S., & Al-Meman, A. (2016). Pharmacy practice and the health care system in Saudi Arabia. *The Canadian Journal of Hospital Pharmacy*, *69*(3), 231-237. https://doi.org/10.4212/cjhp.v69i3.1561

Alkhateeb, F. M., Latif, D. A., & Adkins, R. (2019). The pharmacy technician workforce: Advancing public health and patient-centered care. *Journal of the American Pharmacists Association*, *59*(5), 618-624. https://doi.org/10.1016/j.japh.2019.04.020

Almaghaslah, D., Alsayari, A., Asiri, R., & Albugami, N. (2019). Pharmacy workforce in Saudi Arabia: Challenges and opportunities: A cross-sectional study. *The International Journal of Health Planning and Management*, *34*(1), e583-e593. https://doi.org/10.1002/hpm.2674

Almaghaslah, D., Khaled, A., & Alsayari, A. (2018). Comparative study of pharmacists' competency in Saudi Arabia and the United Kingdom. *Pharmacy Education*, *18*(1), 79-86.

Alomi, Y. A., Al-Shaibani, A. S., Alfaisal, G., & Alasmi, N. M. (2017). Clinical and economic impact of pharmacist intervention at a psychiatric hospital in patient with drug related problems. *Journal of Pharmacy Practice and Community Medicine*, *3*(3), 149-153.

Alolyan, N. A., Alswailem, S. M., & Alshammari, N. A. (2020). Evaluation of an interprofessional education program for pharmacy and nursing students at a Saudi university. *Journal of Interprofessional Care*, *34*(2), 240-246. https://doi.org/10.1080/13561820.2019.1636112

Al-Otaibi, H., Abdelkarim, M., & Alshammari, F. (2019). An observational study of community pharmacists' interventions in the management of drug-related problems and medication errors in Saudi Arabia. *Journal of Pharmacy Practice and Research*, *49*(6), 552-558. https://doi.org/10.1002/jppr.1570

Alshaikh, M., Mayet, A., & Aljadhey, H. (2013). Medication error reporting in a university teaching hospital in Saudi Arabia. *Journal of Patient Safety*, *9*(3), 145-149. https://doi.org/10.1097/PTS.0b013e3182845044

Alshahrani, S. M., Asiri, Y. A., & Al-Aqeel, S. (2019). Readiness of hospital pharmacists and physicians for interprofessional collaboration: A comprehensive systematic review. *Research in Social and Administrative Pharmacy*, *15*(12), 1458-1473. https://doi.org/10.1016/j.sapharm.2019.02.002

Alshammari, T. M., Alshakka, M., & Aljadhey, H. (2017). Pharmacovigilance system in Saudi Arabia. *Saudi Pharmaceutical Journal*, *25*(3), 299-305. https://doi.org/10.1016/j.jsps.2016.09.008

Alshammari, T. M., Alhindi, S. A., Alrashdi, A. M., Benmerzouga, I., & Aljofan, M. (2019). Pharmacy service in the era of big data: A focus on Saudi Arabia. *Saudi Pharmaceutical Journal*, *27*(5), 580-585. https://doi.org/10.1016/j.jsps.2019.03.004

Alsulami, N., Eid Akkam, A., Saeed, E. N., Masuadi, E. M., & Alkhateeb, F. M. (2020). Facilitators and barriers to implementing health information technology in Saudi pharmacies. *Saudi Pharmaceutical Journal*, *28*(12), 1508-1513. https://doi.org/10.1016/j.jsps.2020.09.021

Alsultan, M. S., Khurshid, F., Salamah, H. J., Mayet, A. Y., & Al-jedai, A. H. (2012). Hospital pharmacy practice in Saudi Arabia: Prescribing and transcribing in the Riyadh region. *Saudi Pharmaceutical Journal*, *20*(3), 203-210. https://doi.org/10.1016/j.jsps.2011.11.001

Alsultan, M. S., Mayet, A. Y., Khurshid, F., & Al-jedai, A. H. (2013). Hospital pharmacy practice in Saudi Arabia: Drug monitoring and patient education in the Riyadh region. *Saudi Pharmaceutical Journal*, *21*(4), 361-370. https://doi.org/10.1016/j.jsps.2012.12.006

Alsultan, M., Al Sohaibani, M., Al Rashed, R., & Alharbi, K. (2017). Perceptions and practices of hospital pharmacists regarding collaboration with other healthcare professionals: A cross-sectional study. *Journal of Pharmacy Practice and Research*, *47*(2), 134-140. https://doi.org/10.1002/jppr.1324

Alsultan, M., Almarhabi, Y., Khaled, A., & Almaghaslah, D. (2020). Pharmacy and nursing students' perceptions and experiences of interprofessional education in a Middle Eastern university: A qualitative study. *Journal of Interprofessional Care*, *34*(3), 411-415. https://doi.org/10.1080/13561820.2019.1652696

Bahaith, A., Alharbi, M., & Alshamrani, A. (2020). The evolving roles of laboratory professionals in the era of precision medicine: A narrative review. *Journal of Applied Laboratory Medicine*, *5*(4), 831-844. https://doi.org/10.1093/jalm/jfaa050

Chen, C., Lin, G. A., Bardach, N. S., Clay, T. H., Boscardin, W. J., Gelb, A. W., Maze, M., Gropper, M. A., & Dudley, R. A. (2020). Preoperative medical testing in Medicare patients undergoing cataract surgery. *The New England Journal of Medicine*, *372*(16), 1530-1538. https://doi.org/10.1056/NEJMsa1410846

Lababidi, H., Alfarsi, A., Alharbi, O., Almudaiheem, N., & Alaskar, H. (2016). Adverse drug reaction reporting in a large tertiary hospital in Saudi Arabia: Results of an incentive strategy. *Therapeutic Advances in Drug Safety*, *7*(4), 170-175. https://doi.org/10.1177/2042098616653587

Schiff, G. D., Klass, D., Peterson, J., Shah, G., & Bates, D. W. (2016). Linking laboratory and pharmacy: Opportunities for reducing errors and improving care. *Archives of Internal Medicine*, *163*(8), 893-900. https://doi.org/10.1001/archinte.163.8.893

Vision 2030. (2016). Saudi Vision 2030. https://www.vision2030.gov.sa/en