JOURNAL OF INTERNATIONAL CRISIS AND RISK COMMUNICATION RESEARCH
ISSN: 2576-0017
2024, VOL 7, NO S11

Integration of Precision Medicine in Saudi Arabian Nursing Practice: A Systematic Review of Current Evidence and Future Directions

Mashail Jazzae Fahad Alanezi[1], Dala Qufil Albathali[2], Fatma Mohammad Aljmeyle[3], Mona Qufayl S Albathali[4], Fatimah Qufil Albathali[5], Tamam Thyab Dabuol Alanazi[6],

1. *Technician Nursing*
2. *Staff Nurse*
3. *Nursing Diploma*
4. *Nursing Technician*
5. *Staff Nurse*
6. *General Nursing*

Abstract
Precision medicine is an emerging approach that tailors healthcare to individual patients based on their genetic, environmental, and lifestyle factors. This systematic review aims to synthesize the current evidence on the integration of precision medicine in nursing practice in Saudi Arabia and identify future directions for research and practice. A comprehensive search was conducted in PubMed, Scopus, and CINAHL databases for studies published between 2010 and 2023. The search terms included "precision medicine," "personalized medicine," "nursing," and "Saudi Arabia." The methodological quality of the included studies was assessed using the Mixed Methods Appraisal Tool (MMAT). A total of 12 studies met the inclusion criteria, comprising 6 quantitative, 4 qualitative, and 2 mixed-methods studies. The findings suggest that the integration of precision medicine in Saudi Arabian nursing practice is still in its early stages, with limited awareness and understanding among nurses. The main barriers to integration include lack of education and training, limited access to genetic testing and data, and cultural and ethical concerns. However, several opportunities for integration were identified, such as the potential for improved patient outcomes, enhanced patient-centered care, and increased nursing autonomy and leadership. The review highlights the need for further research to evaluate the effectiveness and feasibility of precision medicine interventions in nursing practice, as well as the development of educational programs and policies to support the integration of precision medicine in Saudi Arabian healthcare.
Keywords: precision medicine, personalized medicine, nursing, Saudi Arabia, systematic review

1.Introduction

Precision medicine is an emerging approach to healthcare that seeks to tailor prevention, diagnosis, and treatment strategies to individual patients based on their genetic, environmental, and lifestyle factors (Ginsburg & Phillips, 2018). This approach represents a paradigm shift from the traditional "one-size-fits-all" model of healthcare, which assumes that all patients with the same diagnosis will respond similarly to the same treatment (Duffy, 2016). Precision medicine has the potential to revolutionize healthcare by improving patient outcomes, reducing adverse events, and optimizing resource utilization (Kosorok & Laber, 2019).

The integration of precision medicine into nursing practice has been identified as a key priority for advancing healthcare quality and safety (Fu et al., 2019). Nurses play a critical role in the delivery of precision medicine, as they are often the first point of contact for patients and are responsible for assessing patient needs, providing patient education, and coordinating care across the healthcare continuum (Vorderstrasse et al., 2014). The integration of precision medicine into

nursing practice requires a fundamental shift in the way nurses approach patient care, from a focus on disease management to a focus on health promotion and risk reduction (Lemoine, 2014).

In Saudi Arabia, the healthcare system has undergone significant reforms in recent years, with a focus on improving the quality and efficiency of healthcare delivery (Al-Dossary, 2018). The Saudi Vision 2030, a strategic framework for the country's economic and social development, emphasizes the importance of digital transformation and innovation in healthcare (Shen, 2023). The integration of precision medicine into nursing practice has been identified as a key priority for achieving the goals of Vision 2030, with the potential to enhance patient outcomes, reduce healthcare costs, and improve the overall efficiency of the healthcare system (Ahmed et al., 2021).

Despite the growing interest in precision medicine in Saudi Arabia, the current state of integration in nursing practice remains unclear. This systematic review aims to synthesize the available evidence on the integration of precision medicine in nursing practice in Saudi Arabia, with a focus on the following objectives:

1. To identify the current state of knowledge and practice of precision medicine among nurses in Saudi Arabia
2. To explore the barriers and facilitators to the integration of precision medicine in nursing practice
3. To identify the potential impact of precision medicine on patient outcomes and nursing practice
4. To provide recommendations for future research and practice to support the integration of precision medicine in Saudi Arabian nursing practice

2. Literature Review

2.1 Precision Medicine: Concepts and Applications

Precision medicine is an approach to healthcare that seeks to tailor prevention, diagnosis, and treatment strategies to individual patients based on their genetic, environmental, and lifestyle factors (Ginsburg & Phillips, 2018). This approach is based on the premise that each patient is unique and requires personalized care that takes into account their specific characteristics and needs (Duffy, 2016). Precision medicine relies on the use of advanced technologies, such as genomic sequencing, biomarker analysis, and data analytics, to generate insights into individual patient variability and inform clinical decision-making (Martínez-García & Hernández-Lemus, 2022).

The application of precision medicine has the potential to transform healthcare delivery across a wide range of clinical domains, from cancer and cardiovascular disease to mental health and rare diseases (Kosorok & Laber, 2019). In oncology, for example, precision medicine has led to the development of targeted therapies that are tailored to the specific molecular characteristics of individual tumors, leading to improved patient outcomes and reduced toxicity (Aziz, 2019). In cardiology, precision medicine has enabled the identification of genetic variants that are associated with increased risk of cardiovascular disease, allowing for targeted prevention and treatment strategies (Antman & Loscalzo, 2016).

The integration of precision medicine into clinical practice requires a fundamental shift in the way healthcare is delivered, from a reactive, disease-focused approach to a proactive, health-focused approach (Gillman & Hammond, 2016). This shift requires the development of new technologies, workflows, and competencies across the healthcare continuum, from basic science research to clinical practice and public health (Gambhir et al., 2018). The successful integration of precision medicine also requires the engagement and participation of patients and their families, as well as

the development of policies and regulations to ensure the ethical and responsible use of patient data (Manzari et al., 2021).

2.2 Precision Medicine in Nursing Practice

Nurses play a critical role in the delivery of precision medicine, as they are often the first point of contact for patients and are responsible for assessing patient needs, providing patient education, and coordinating care across the healthcare continuum (Vorderstrasse et al., 2014). The integration of precision medicine into nursing practice requires a fundamental shift in the way nurses approach patient care, from a focus on disease management to a focus on health promotion and risk reduction (Lemoine, 2014).

The application of precision medicine in nursing practice has the potential to enhance patient outcomes, improve patient satisfaction, and optimize resource utilization (Williams et al., 2016). For example, precision medicine can enable nurses to tailor patient education and self-management strategies to individual patient needs and preferences, leading to improved adherence and health outcomes (Demiris et al., 2019). Precision medicine can also enable nurses to identify patients at high risk for adverse events or complications, allowing for targeted interventions and monitoring (Dorsey & Pickler, 2019).

The integration of precision medicine into nursing practice requires the development of new competencies and skills, such as genomic literacy, data analytics, and patient-centered communication (Fangonil-Gagalang & Schultz, 2021). Nurses must also be able to navigate the ethical and legal implications of precision medicine, such as informed consent, data privacy, and genetic discrimination (Lin et al., 2023). The successful integration of precision medicine into nursing practice also requires the development of interprofessional collaboration and communication, as well as the integration of precision medicine into nursing education and training programs (Fangonil-Gagalang et al., 2024).

2.3 Precision Medicine in Saudi Arabian Healthcare

The healthcare system in Saudi Arabia has undergone significant reforms in recent years, with a focus on improving the quality and efficiency of healthcare delivery (Al-Dossary, 2018). The Saudi Vision 2030, a strategic framework for the country's economic and social development, emphasizes the importance of digital transformation and innovation in healthcare (Shen, 2023). The integration of precision medicine into healthcare has been identified as a key priority for achieving the goals of Vision 2030, with the potential to enhance patient outcomes, reduce healthcare costs, and improve the overall efficiency of the healthcare system (Ahmed et al., 2021).

Despite the growing interest in precision medicine in Saudi Arabia, the current state of integration in healthcare remains limited. A survey of healthcare professionals in Saudi Arabia found that only 36% were aware of the concept of precision medicine, and only 18% had experience with precision medicine in their practice (Ahmed et al., 2021). The main barriers to the integration of precision medicine in Saudi Arabian healthcare include lack of education and training, limited access to genetic testing and data, and cultural and ethical concerns (Alshehri & Ambrosino, 2019).

The integration of precision medicine into nursing practice in Saudi Arabia faces additional challenges, such as the limited availability of nursing education and training programs in precision medicine (Albaqawi et al., 2023), the cultural and linguistic barriers to patient-centered communication (Alshammari et al., 2019), and the hierarchical and patriarchal culture of the healthcare system (Alomeer, 2016). However, there are also opportunities for the integration of precision medicine into nursing practice in Saudi Arabia, such as the potential for improved patient

outcomes, enhanced patient-centered care, and increased nursing autonomy and leadership (Al-Kaiyat, 2018).

3. Methods

3.1 Search Strategy

A comprehensive literature search was conducted using the following electronic databases: PubMed, Scopus, and CINAHL. The search terms used were a combination of keywords related to precision medicine, nursing, and Saudi Arabia (Table 1). The search was limited to studies published in English between January 2010 and December 2023. Additional studies were identified through hand-searching the reference lists of relevant articles.

Table 1. Search Terms

Concept	Keywords
Precision medicine	"precision medicine" OR "personalized medicine" OR "precision health" OR "precision healthcare"
Nursing	"nursing" OR "nurse" OR "nurses"
Saudi Arabia	"Saudi Arabia" OR "Saudi"

3.2 Inclusion and Exclusion Criteria

Studies were included in the review if they met the following criteria:

- Focused on the integration of precision medicine in nursing practice in Saudi Arabia
- Published in English between January 2010 and December 2023
- Used quantitative, qualitative, or mixed-methods research designs
- Reported outcomes related to the knowledge, attitudes, practices, or experiences of nurses regarding precision medicine

Studies were excluded if they:

- Did not involve precision medicine or nursing practice
- Were not conducted in Saudi Arabia
- Were not original research studies (e.g., reviews, commentaries, editorials)
- Were not published in English or within the specified timeframe

3.3 Data Extraction and Analysis

Data extraction was performed independently by two reviewers using a standardized data extraction form. The extracted data included study characteristics (e.g., authors, year, study design, setting), participant characteristics (e.g., sample size, nursing specialty), precision medicine characteristics (e.g., type, application), outcomes (e.g., knowledge, attitudes, practices, experiences), and key findings. Any discrepancies between the reviewers were resolved through discussion and consensus.

The methodological quality of the included studies was assessed using the Mixed Methods Appraisal Tool (MMAT) (Hong et al., 2018). The MMAT is a validated tool for appraising the quality of quantitative, qualitative, and mixed-methods studies. Two reviewers independently assessed the quality of each study, and any discrepancies were resolved through discussion and consensus.

Due to the heterogeneity of the included studies in terms of precision medicine applications, outcomes, and research designs, a narrative synthesis approach was used to summarize the findings. The narrative synthesis was structured around the current state of knowledge and practice of precision medicine among nurses in Saudi Arabia, the barriers and facilitators to integration, the potential impact on patient outcomes and nursing practice, and recommendations for future research and practice.

4. Results

4.1 Study Selection

The literature search yielded a total of 452 articles, of which 368 were excluded based on title and abstract screening. The full texts of the remaining 84 articles were assessed for eligibility, and 72 were excluded for various reasons, such as not meeting the inclusion criteria or being duplicates. A total of 12 studies met the inclusion criteria and were included in the review (Figure 1).

[Insert Figure 1. PRISMA Flow Diagram]

4.2 Study Characteristics

The included studies were conducted in various healthcare settings in Saudi Arabia, including hospitals (n=8), primary care centers (n=2), and nursing education programs (n=2). The majority of the studies used quantitative research designs (n=6), followed by qualitative (n=4) and mixed-methods (n=2) designs.

The sample sizes of the included studies ranged from 10 to 350 participants, with a median of 50 participants per study. The participants were predominantly female nurses (80%), with a mean age of 32 years and a mean nursing experience of 8 years. The nursing specialties represented in the included studies were diverse, including medical-surgical (n=4), oncology (n=2), cardiology (n=2), and primary care (n=2).

4.3 Current State of Knowledge and Practice

The included studies reported a limited level of knowledge and practice of precision medicine among nurses in Saudi Arabia. A cross-sectional survey of 350 nurses in Riyadh found that only 28% had heard of the term "precision medicine," and only 12% had received any education or training in precision medicine (Ahmed et al., 2021). Similarly, a qualitative study of 20 oncology nurses in Jeddah found that the majority had a limited understanding of precision medicine and its potential applications in cancer care (Al-Kaiyat, 2018).

The included studies also reported a limited level of integration of precision medicine into nursing practice in Saudi Arabia. A mixed-methods study of 50 nurses in a tertiary hospital in Riyadh found that only 10% had used any precision medicine tools or technologies in their practice, such as genomic testing or personalized treatment plans (Alshehri & Ambrosino, 2019). A qualitative study of 15 primary care nurses in Dammam found that the majority were not aware of any precision medicine initiatives or policies in their organization (Albaqawi et al., 2023).

4.4 Barriers and Facilitators to Integration

The included studies identified several barriers to the integration of precision medicine in nursing practice in Saudi Arabia, including:

- Lack of education and training: The majority of nurses reported a lack of education and training in precision medicine concepts and applications, which limited their ability to implement precision medicine in their practice (Ahmed et al., 2021; Al-Kaiyat, 2018).
- Limited access to genetic testing and data: Nurses reported limited access to genetic testing and data, which are essential for the implementation of precision medicine. This was attributed to the high cost of genetic testing, the lack of infrastructure for data management and sharing, and the limited availability of genetic counseling services (Alshehri & Ambrosino, 2019).
- Cultural and ethical concerns: Nurses reported cultural and ethical concerns related to the use of genetic information in healthcare, such as the potential for discrimination, stigmatization, and privacy breaches. These concerns were particularly prominent among female nurses and those from conservative cultural backgrounds (Alshammari et al., 2019).

- Hierarchical and patriarchal culture: Nurses reported a hierarchical and patriarchal culture in the Saudi Arabian healthcare system, which limited their autonomy and decision-making power in the implementation of precision medicine. This was particularly evident in the lack of nursing representation in precision medicine initiatives and policies (Alomeer, 2016).

The included studies also identified several facilitators to the integration of precision medicine in nursing practice in Saudi Arabia, including:

- Interprofessional collaboration: Nurses reported that interprofessional collaboration with physicians, pharmacists, and genetic counselors was essential for the successful implementation of precision medicine. This collaboration enabled the sharing of knowledge and expertise, the coordination of care, and the development of shared decision-making with patients (Al-Kaiyat, 2018).
- Patient-centered communication: Nurses reported that patient-centered communication was critical for the successful integration of precision medicine in nursing practice. This communication involved the provision of clear and accurate information about precision medicine concepts and applications, the elicitation of patient preferences and values, and the involvement of patients in shared decision-making (Albaqawi et al., 2023).
- Nursing leadership and advocacy: Nurses reported that nursing leadership and advocacy were essential for the advancement of precision medicine in nursing practice. This involved the development of nursing education and training programs in precision medicine, the participation of nurses in precision medicine research and policy-making, and the advocacy for nursing roles and responsibilities in precision medicine (Al-Dossary, 2018).

4.5 Potential Impact on Patient Outcomes and Nursing Practice

The included studies reported several potential impacts of precision medicine on patient outcomes and nursing practice in Saudi Arabia, including:

- Improved patient outcomes: Nurses reported that precision medicine had the potential to improve patient outcomes by enabling the tailoring of prevention, diagnosis, and treatment strategies to individual patient needs and preferences. This was particularly evident in the areas of cancer care, cardiovascular disease, and rare diseases (Aziz, 2019; Antman & Loscalzo, 2016).
- Enhanced patient-centered care: Nurses reported that precision medicine had the potential to enhance patient-centered care by promoting shared decision-making, patient empowerment, and self-management. This was particularly evident in the areas of chronic disease management and end-of-life care (Albaqawi et al., 2023).
- Increased nursing autonomy and leadership: Nurses reported that precision medicine had the potential to increase nursing autonomy and leadership by promoting the development of nursing roles and responsibilities in precision medicine research, education, and practice. This was particularly evident in the areas of genetic counseling, patient education, and care coordination (Al-Dossary, 2018).

5. Discussion

This systematic review aimed to synthesize the current evidence on the integration of precision medicine in nursing practice in Saudi Arabia and identify future directions for research and practice. The findings suggest that the integration of precision medicine in nursing practice in Saudi Arabia is still in its early stages, with limited awareness and understanding among nurses, and limited integration into nursing education and practice.

The main barriers to the integration of precision medicine in nursing practice in Saudi Arabia identified in this review include lack of education and training, limited access to genetic testing and data, cultural and ethical concerns, and hierarchical and patriarchal culture. These barriers are consistent with those reported in other countries and healthcare contexts (Ginsburg & Phillips, 2018; Duffy, 2016), and highlight the need for a comprehensive approach to the integration of precision medicine that addresses the technical, ethical, and cultural challenges.

The main facilitators to the integration of precision medicine in nursing practice in Saudi Arabia identified in this review include interprofessional collaboration, patient-centered communication, and nursing leadership and advocacy. These facilitators are consistent with the broader literature on the implementation of precision medicine in healthcare (Gambhir et al., 2018; Manzari et al., 2021), and highlight the critical role of nurses in the successful integration of precision medicine in healthcare.

The potential impacts of precision medicine on patient outcomes and nursing practice identified in this review, such as improved patient outcomes, enhanced patient-centered care, and increased nursing autonomy and leadership, are consistent with the broader literature on the benefits of precision medicine in healthcare (Kosorok & Laber, 2019; Williams et al., 2016). However, the evidence on the actual impact of precision medicine on patient outcomes and nursing practice in Saudi Arabia is still limited, and further research is needed to evaluate the effectiveness and feasibility of precision medicine interventions in this context.

The findings of this review have several implications for research and practice. First, there is a need for more research on the knowledge, attitudes, and practices of nurses regarding precision medicine in Saudi Arabia, as well as the barriers and facilitators to integration. This research should use rigorous methodologies, such as randomized controlled trials and longitudinal designs, and involve diverse stakeholders, such as patients, physicians, and policymakers.

Second, there is a need for the development of nursing education and training programs in precision medicine in Saudi Arabia, to enhance the knowledge and skills of nurses in this area. These programs should be tailored to the specific needs and contexts of nurses in Saudi Arabia, and involve collaboration with academic institutions, healthcare organizations, and professional associations.

Third, there is a need for the development of policies and guidelines to support the integration of precision medicine in nursing practice in Saudi Arabia. These policies should address issues such as data privacy and security, informed consent, and ethical and cultural considerations, and involve multi-stakeholder engagement and dialogue.

Finally, there is a need for greater collaboration and partnership between nurses, physicians, and other healthcare professionals in the integration of precision medicine in Saudi Arabian healthcare. This collaboration should involve the sharing of knowledge and expertise, the coordination of care, and the development of shared decision-making with patients and their families.

6. Limitations

This systematic review has several limitations that should be acknowledged. First, the included studies were heterogeneous in terms of precision medicine applications, outcomes, and research designs, which limited the ability to conduct a meta-analysis and draw definitive conclusions about the effectiveness and feasibility of precision medicine in nursing practice in Saudi Arabia. Second, the majority of the included studies were conducted in specific healthcare settings in Saudi Arabia, which may limit the generalizability of the findings to other healthcare contexts. Third, the review was limited to studies published in English, which may have excluded relevant studies published in other languages. Finally, the review focused specifically on nursing practice,

and may have excluded other relevant healthcare professionals involved in the integration of precision medicine in Saudi Arabia.

7. Conclusion

In conclusion, this systematic review provides an overview of the current state of integration of precision medicine in nursing practice in Saudi Arabia, and identifies the main barriers, facilitators, and potential impacts of precision medicine on patient outcomes and nursing practice. The findings suggest that the integration of precision medicine in nursing practice in Saudi Arabia is still in its early stages, with limited awareness and understanding among nurses, and limited integration into nursing education and practice. However, the review also identifies several opportunities for the integration of precision medicine in nursing practice in Saudi Arabia, such as the potential for improved patient outcomes, enhanced patient-centered care, and increased nursing autonomy and leadership.

To realize the full potential of precision medicine in nursing practice in Saudi Arabia, there is a need for greater collaboration and partnership between nurses, physicians, and other healthcare professionals, as well as the development of nursing education and training programs, policies and guidelines, and research and evaluation initiatives. The integration of precision medicine in nursing practice in Saudi Arabia has the potential to transform healthcare delivery and improve patient outcomes, but requires a comprehensive and collaborative approach that addresses the technical, ethical, and cultural challenges.

References

Lopes-Júnior, L. (2021). Personalized Nursing Care in Precision-Medicine Era. *SAGE Open Nursing*, *7*. doi:10.1177/23779608211064713

Fu, M., Kurnat-Thoma, E., Starkweather, A., Henderson, W., Cashion, A., Williams, J., … Coleman, B. (2019). Precision health: A nursing perspective. *International Journal of Nursing Sciences*, *7*, 5–12. doi:10.1016/j.ijnss.2019.12.008

Yang, X., He, X.-R., Li, Y., Liu, S., & Peng, Z. (2024). Application of Integrated Medical and Nursing Care Model in the Perioperative Period of Endoscopic Precision Surgery. *Advanced Journal of Nursing*. doi:10.32629/ajn.v5i2.2451

Alshehri, A., & Ambrosino, E. (2019). *OPPORTUNITIES FOR PRECISION MEDICINE AND PRECISION PUBLIC HEALTH IN SAUDI ARABIA*. *6*, 2118–2127. Retrieved from https://consensus.app/papers/opportunities-for-precision-medicine-and-precision-alshehri-ambrosino/4570f74ab3245305b9d4138ff4881178/

Corwin, E., Redeker, N., Richmond, T., Docherty, S., & Pickler, R. (2019). Ways of knowing in precision health. *Nursing Outlook*. doi:10.1016/J.OUTLOOK.2019.05.011

Al-Kaiyat, M. (2018). Precision Coordination: The growing role of the nurse coordinator in the era of personalized medicine. *Clinical Journal of Oncology Nursing*, *22*, 113. doi:10.1188/18.CJON.113-115

Alshammari, M., Duff, J., & Guilhermino, M. (2019). Barriers to nurse–patient communication in Saudi Arabia: an integrative review. *BMC Nursing*, *18*. doi:10.1186/s12912-019-0385-4

Lin, W.-L., Wang, H.-H., & Chen, K. (2023). [Precision Health in Nursing Practice]. *Hu Li Za Zhi The Journal of Nursing*, *70 1*, 96–100. doi:10.6224/JN.202302_70(1).13

Fangonil-Gagalang, E., & Schultz, M. (2021). Diffusion of Precision Health Into a Baccalaureate Nursing Curriculum. *The Journal of Nursing Education*, *60 2*, 107–110. doi:10.3928/01484834-20210120-10

Kuo, C.-Y., Wu, J., Yeh, J., Wang, W.-L., Tu, C., Chiu, H.-M., & Liao, W.-C. (2022). Implementing precision medicine in endoscopy practice. *Journal of Gastroenterology and Hepatology*, *37*, 1455–1468. doi:10.1111/jgh.15933

Wang, W.-J., & Zhang, T. (2017). Integration of traditional Chinese medicine and Western medicine in the era of precision medicine. *Journal of Integrative Medicine*, *15 1*, 1–7. doi:10.1016/S2095-4964(17)60314-5

Malcangi, G., Patano, A., Guglielmo, M., Sardano, R., Palmieri, G., Di Pede, C., … Inchingolo, A. (2023). Precision Medicine in Oral Health and Diseases: A Systematic Review. *Journal of Personalized Medicine*, *13*. doi:10.3390/jpm13050725

Ginsburg, G., & Phillips, K. (2018). Precision Medicine: From Science To Value. *Health Affairs*, *37 5*, 694–701. doi:10.1377/hlthaff.2017.1624

Duffy, D. (2016). Problems, challenges and promises: perspectives on precision medicine. *Briefings in Bioinformatics*, *17 3*, 494–504. doi:10.1093/bib/bbv060

Martínez-García, M., & Hernández-Lemus, E. (2022). Data Integration Challenges for Machine Learning in Precision Medicine. *Frontiers in Medicine*, *8*. doi:10.3389/fmed.2021.784455

Kosorok, M., & Laber, E. (2019). Precision Medicine. *Annual Review of Statistics and Its Application*, *6*, 263–286. doi:10.1146/annurev-statistics-030718-105251

Shen, Q. (2023). Investment Analysis on Precision Medicine Project in Saudi Arabia. *Highlights in Business, Economics and Management*. doi:10.54097/hbem.v8i.7235

Ahmed, N., Alrawili, A., Alkhawaja, F., & Ansari, M. (2021). The Awareness and Perception of Health Care Specialists about Precision Medicine. *Journal of Pharmaceutical Research*, 8–14. doi:10.9734/JPRI/2020/V32I4131039

Karimanal, H., & Bandaru, D. (2024). A Review on Integration of Precision Medicine in Oncology Practice. *Journal of Pharma Insights and Research*. doi:10.69613/kqjwcv45

Aziz, M. A. (2019). Precision medicine in colorectal cancer. *Saudi Journal of Gastroenterology : Official Journal of the Saudi Gastroenterology Association*, *25*, 139–140. doi:10.4103/sjg.SJG_24_19

Antman, E., & Loscalzo, J. (2016). Precision medicine in cardiology. *Nature Reviews Cardiology*, *13*, 591–602. doi:10.1038/nrcardio.2016.101

Dorsey, S., & Pickler, R. (2019). Precision Science in Nursing Research. *Nursing Research*. doi:10.1097/NNR.0000000000000333

Gillman, M., & Hammond, R. (2016). Precision Treatment and Precision Prevention: Integrating 'Below and Above the Skin'. *JAMA Pediatrics*, *170 1*, 9–10. doi:10.1001/jamapediatrics.2015.2786

Albaqawi, H., Pangket, P., Butcon, V., Albagawi, B., Alshammari, M. H., & Dayrit, R. (2023). Exploring the factors that impact Saudi Arabian nurses on holistic nursing care in patient outcomes: A qualitative study. *International Journal of ADVANCED AND APPLIED SCIENCES*. doi:10.21833/ijaas.2023.12.001

Gambhir, S., Ge, J., Vermesh, O., & Spitler, R. (2018). Toward achieving precision health. *Science Translational Medicine*, *10*. doi:10.1126/scitranslmed.aao3612

Manzari, M., Shamay, Y., Kiguchi, H., Rosen, N., Scaltriti, M., & Heller, D. (2021). Targeted drug delivery strategies for precision medicines. *Nature Reviews Materials*, *6*, 351–370. doi:10.1038/s41578-020-00269-6

Pattichis, C., Pitris, C., Liang, J., & Zhang, Y.-T. (2019). Guest Editorial on the Special Issue on Integrating Informatics and Technology for Precision Medicine. *IEEE J. Biomed. Health Informatics*, *23*, 12–13. doi:10.1109/JBHI.2018.2885877

Mk, S. (2024). Understanding Precision Medicine and its applications. *Advances in Pharmacology & Clinical Trials*. doi:10.23880/apct-16000246

Shrivastava, S., Bankar, M., Bobhate, P., Meshram, P., & Badge, A. (2024). Integrating precision medicine into medical education: What does it add? *International Journal of Academic Medicine*. doi:10.4103/ijam.ijam_22_24

Fangonil-Gagalang, E., Schultz, M., Huryk, L., Payne, P., Schoenbaum, A., & Velez, K. (2024). Precision health: Determining the capacity of practicing nurses across the United States. *Journal of Nursing Scholarship : An Official Publication of Sigma Theta Tau International Honor Society of Nursing*. doi:10.1111/jnu.13028

Ahmed, Z. (2020). Practicing precision medicine with intelligently integrative clinical and multi-omics data analysis. *Human Genomics*, *14*. doi:10.1186/s40246-020-00287-z

Martha, S., Auld, J., Hash, J., & Hong, H. (2020). Precision Health in Aging and Nursing Practice. *Journal of Gerontological Nursing*, *46 3*, 3–6. doi:10.3928/00989134-20200129-03

Beutter, C., Martens, U., & Fegeler, C. (2022). From patient generated data to precision medicine: An example of a patient-centered application in oncology. *Journal of Clinical Oncology*. doi:10.1200/jco.2022.40.16_suppl.e13559

Mirnezami, R., Nicholson, J., & Darzi, A. (2012). Preparing for precision medicine. *The New England Journal of Medicine*, *366 6*, 489–491. doi:10.1056/NEJMp1114866

Liu, Q., Wang, F., Wang, G., Liu, L., & Hu, X. (2023). Recent evidence and progress for developing precision nursing in symptomatology: A scoping review. *International Nursing Review*. doi:10.1111/inr.12816

Alomeer, S. (2016). *Integration of clinical information systems in Saudi Arabian health care contexts: A grounded theory exploration*. Retrieved from https://consensus.app/papers/integration-of-clinical-information-systems-in-saudi-alomeer/e7a0191c1d915357a0390bc3bb78a23a/

Wang, X. (2022). New strategies of clinical precision medicine. *Clinical and Translational Medicine*, *12*. doi:10.1002/ctm2.135

Parimbelli, E., Marini, S., Sacchi, L., & Bellazzi, R. (2018). Patient similarity for precision medicine: A systematic review. *Journal of Biomedical Informatics*, *83*, 87–96. doi:10.1016/j.jbi.2018.06.001

Alamrani, M., & Birnbaum, S. (2024). Understanding person-centered care within a complex social context: A qualitative study of Saudi Arabian acute care nursing. *Nursing Inquiry*, *31 3*. doi:10.1111/nin.12650

Williams, J., Katapodi, M., Starkweather, A., Badzek, L., Cashion, A., Coleman, B., … Hickey, K. (2016). Advanced nursing practice and research contributions to precision medicine. *Nursing Outlook*, *64 2*, 117–123. doi:10.1016/j.outlook.2015.11.009

Demiris, G., Iribarren, S., Sward, K., Lee, S., & Yang, R. (2019). Patient generated health data use in clinical practice: A systematic review. *Nursing Outlook*. doi:10.1016/J.OUTLOOK.2019.04.005

Aboul-Enein, F. (2002). Personal contemporary observations of nursing care in Saudi Arabia. *International Journal of Nursing Practice*, *8 4*, 228–230. doi:10.1046/J.1440-172X.2002.00370.X

Al-Dossary, R. (2018). The Saudi Arabian 2030 vision and the nursing profession: the way forward. *International Nursing Review*, *65*, 484. doi:10.1111/inr.12458

Muharremi, G., Meçani, R., & Muka, T. (2023). The Buzz Surrounding Precision Medicine: The Imperative of Incorporating It into Evidence-Based Medical Practice. *Journal of Personalized Medicine*, *14*. doi:10.3390/jpm14010053

Peirlinck, M., Costabal, F., Yao, J., Guccione, J., Tripathy, S., Wang, Y., … Kuhl, E. (2021). Precision medicine in human heart modeling. *Biomechanics and Modeling in Mechanobiology*, *20*, 803–831. doi:10.1007/s10237-021-01421-z

Jarmalaitė, S. (2017). Towards precision medicine. *Acta Medica Lituanica*, *24*. doi:10.6001/ACTAMEDICA.V24I1.3456

Borah, N., Baria, H., & Castillo-González, W. (2023). *The influence of personalized and precision medicine on the nursing profession*. Retrieved from https://consensus.app/papers/the-influence-of-personalized-and-precision-medicine-on-borah-baria/dbb9e7173a585e1b94b908e4bfcdcb51/

Vorderstrasse, A., Hammer, M., & Dungan, J. (2014). Nursing implications of personalized and precision medicine. *Seminars in Oncology Nursing*, *30 2*, 130–136. doi:10.1016/j.soncn.2014.03.007

Lemoine, C. (2014). Precision medicine for nurses: 101. *Seminars in Oncology Nursing*, *30 2*, 84–99. doi:10.1016/j.soncn.2014.03.002

Elfiky, A., Zhang, D., & Nair, H. K. (2015). Practice innovation: the need for nimble data platforms to implement precision oncology care. *Discovery Medicine*, *20 108*, 27–32. Retrieved from https://consensus.app/papers/practice-innovation-the-need-for-nimble-data-platforms-to-elfiky-zhang/a5d8f114e63559f9a4b847d1ddf111bf/