Ethical and Legal Implications of Artificial Intelligence in Infection Prevention and Control: A Saudi Arabian Perspective

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Abstract

Background: Artificial intelligence (AI) is transforming infection prevention and control (IPC), enabling earlier outbreak detection, enhanced infection monitoring, and improved patient safety. In Saudi Arabia, these advancements support Vision 2030 and initiatives led by the Saudi Data and Artificial Intelligence Authority (SDAIA). However, they also raise significant ethical and legal challenges, including patient rights, data protection, algorithmic bias, and liability concerns.

Objective: This article examines the ethical and legal implications of AI in IPC within the Saudi healthcare context, integrating global standards with national regulations and Islamic bioethical principles.

Methods: A critical review of Saudi regulatory instruments, including the Personal Data Protection Law (PDPL), and relevant Islamic bioethical concepts such as maslahah (public interest), adl (justice), and amanah (trust), is conducted. The analysis incorporates insights from global AI governance frameworks and contributions from Saudi legal scholarship.

Results: The study identifies key issues in AI-driven IPC—consent, fairness, transparency, privacy, and accountability—highlighting gaps in liability allocation and data ownership. It proposes an integrated ethical-legal framework aligning AI deployment with both international norms and the cultural-ethical fabric of Saudi Arabia.

Conclusions: Embedding AI in Saudi IPC systems demands robust ethical oversight, legal clarity, and cultural legitimacy. By integrating statutory law and Islamic bioethics, Saudi Arabia can pioneer a model of responsible AI adoption that advances Vision 2030 while safeguarding patient rights and societal trust.

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Ethical and Legal Implications of Artificial Intelligence in Infection Prevention and Control: A Saudi Arabian Perspective

Abstract

The growing role of artificial intelligence (AI) in infection prevention and control (IPC) is reshaping healthcare as we know it, making it possible to detect outbreaks earlier, monitor infections more effectively, and keep patients safer. In Saudi Arabia, these advances closely align with the ambitions of Vision 2030 and national strategies led by the Saudi Data and Artificial Intelligence Authority (SDAIA). But with this rapid progress comes a new set of ethical and legal questions, especially around patient rights, data protection, bias in algorithms, and who is held responsible when things go wrong.

This article takes a closer look at these concerns within the Saudi healthcare landscape. It explores key issues such as informed consent, fairness, transparency, and the protection of patient confidentiality, through the lens of both global ethical standards and local laws, especially the Kingdom's Personal Data Protection Law (PDPL). It also examines challenges that are still evolving, like questions of legal liability and the ownership of health data.

Importantly, the discussion is grounded in values drawn from Islamic bioethics, *maslahah* (public interest), *adl* (justice), and *amanah* (trust), as well as contributions from Saudi legal scholars. By weaving together technological innovation, legal insight, and cultural values, this article offers a balanced framework for using AI in healthcare that respects both global norms and the unique ethical fabric of Saudi society. This is the first integrated Saudi legal–ethical framework for AI in IPC

Keywords: Artificial Intelligence (AI), Infection Prevention and Control (IPC), Health Law, Saudi Arabia, Medical Ethics, Islamic Bioethics, Data Privacy, AI Governance, Digital Health, Public Health Surveillance, Algorithmic Accountability, Patient Confidentiality, Healthcare Technology, AI Ethics in Medicine

1. Introduction

Artificial intelligence (AI) is rapidly reshaping healthcare systems across the globe. In infection prevention and control (IPC), AI is already demonstrating its potential**,** enabling earlier outbreak detection, enhancing surveillance, and supporting clinical decision-making. These technologies promise to improve patient safety and healthcare efficiency in ways previously unimaginable (Topol,

2019; WHO, 2021).

In Saudi Arabia, this technological momentum aligns with the Kingdom's Vision 2030 and national strategies led by the Saudi Data and Artificial Intelligence Authority (SDAIA). Key initiatives like the National Strategy for Data and AI (NSDAI) and the Ministry of Health's Digital Health Strategy emphasize the role of AI in transforming healthcare infrastructure, particularly in critical areas like IPC (SDAIA, 2021). Yet, with such innovation come complex ethical, legal, and cultural questions that require careful navigation.

While the benefits of AI in healthcare are clear, its deployment**,** especially in sensitive domains such as IPC**,** should be guided by frameworks that reflect both international standards and local values. In Saudi Arabia, healthcare governance operates through a unique model of legal pluralism. Ethical decision-making is shaped not only by statutory laws, such as the Personal Data Protection Law (PDPL), but also by principles rooted in Islamic bioethics, including maslahah (public interest), adl (justice), and amanah (trust) (Sachedina, 2009). These values provide a moral compass for assessing emerging technologies and ensuring that innovation remains aligned with national identity and religious integrity.

Globally, the COVID-19 pandemic accelerated the integration of AI into IPC systems, providing timely evidence of its utility. Countries deployed AI tools for real-time digital contact tracing, predictive modeling, and infection risk assessment (Gawande et al., 2025). According to the World Health Organization, AI's ability to process large-scale health data**,** from electronic health records to environmental sensors**,** enhanced the effectiveness of public health responses (WHO, 2021). Saudi Arabia was no exception. Digital applications like Tawakkalna and Tabaud played a key role in pandemic management, reflecting how AI can complement traditional epidemiological methods when embedded in a strong regulatory and ethical framework (Topol, 2019).

However, the promise of AI extends beyond its technical capabilities. Its real value lies in its ability to operate within ethical boundaries that respect patient autonomy, confidentiality, and fairness (Elmajub E., 2023; Mustapha et al.,2025; Kannike, 2025; Elgujja, 2024). In IPC, where decisions often involve balancing individual rights with public safety, this balance is particularly delicate. AI-driven surveillance tools, predictive algorithms, and autonomous decision support systems should be accountable, transparent, and sensitive to local cultural expectations (Gamon, 2023).

This article critically examines the ethical and legal implications of AI adoption in IPC within Saudi Arabia. It explores how AI can support infection control while respecting core values, legal responsibilities, and the Islamic moral tradition. Specific attention is given to issues such as informed consent, privacy, algorithmic bias, liability, and governance. By drawing on both international best

practices and Islamic bioethical scholarship, the paper proposes a regulatory framework tailored to the Saudi context**,** one that ensures AI innovation does not compromise human dignity, patient rights, or societal trust.

In doing so, the article offers more than a technical review; it presents a vision for culturally grounded and ethically responsible AI integration in healthcare. Saudi Arabia's digital transformation presents an opportunity not only to adopt cutting-edge technologies but also to lead globally in ethical AI governance that reflects both tradition and progress (Gawande et al., 2025).

2. Applications of AI in Infection Prevention and Control

AI tools are increasingly used to enhance IPC protocols through real-time surveillance, computer vision-based hygiene monitoring, predictive analytics, and automated alert systems. For example, service robots guided by AI and sensor data, can clean hospital environments reduce infection risk and lower traditional cleaning and disinfection costs, marking a significant advancement in sustainable infection control infrastructure (Sadek et al., 2024). These technologies also assist in training healthcare workers, promoting compliance with hygiene standards and improving institutional practices.

AI technologies extend far beyond traditional digital surveillance. Recent research emphasizes that AI-based surveillance systems are more accurate and less error-prone than manual methods, enabling better control of infection risks across multiple IPC domains (Sadek et al., 2024). Applications include hand hygiene monitoring, waste management, surveillance of healthcare-associated infections, and training healthcare workers to enhance performance and compliance with protocols.

One of the most impactful applications lies in predictive analytic, which enables the modeling of outbreak trajectories using real-time data from diverse sources, including hospital admission patterns, climate variables, laboratory reports, and even population mobility data. For instance, machine learning models have been successfully applied to forecast influenza outbreaks and COVID-19 waves by integrating EHR data with weather and mobility trends (Cheng et al., 2025; Santillana et al., 2020). These systems allow for proactive interventions, resource optimization, and better preparedness in high-risk settings.

Machine learning algorithms also assist in the early detection of hospital-acquired infections (HAIs) and device-associated infections such as ventilator associated pneumonia, central line associated blood stream infection etc. By analyzing large volumes of structured and unstructured clinical data,

such as vital signs, medication use, and lab results, these models can flag at-risk patients well before symptoms fully manifest, facilitating early and potentially life-saving treatment (Taylor et al., 2016; Rajkomar et al., 2019).

Beyond outbreak forecasting and infection surveillance, AI further supports clinicians in diagnosing infections and formulating personalized treatment plans. AI has demonstrated strong potential in clinical diagnosis and individualized treatment planning. According to Alowais et al. (2023), AI supports clinicians by assisting in diagnostic accuracy, enabling personalized treatment strategies, and enhancing medical decision-making through large-scale data processing and pattern recognition. These applications, when integrated into infection control workflows, can help identify at-risk patients faster and allocate preventive interventions more efficiently, especially in high-pressure hospital settings.

On the other hand, Natural Language Processing (NLP) plays a crucial role in extracting valuable insights from free-text clinical notes, radiology reports, and pathology findings. NLP has been used to identify early indicators of infection that may not be captured in structured fields, improving the comprehensiveness of infection surveillance systems (Gehrmann et al., 2018). This approach bridges gaps in traditional IPC methods by revealing subtle patterns often overlooked by human reviewers.

Rather than replacing clinicians, these technologies serve as digital companions, supporting judgment, reducing human error, and ensuring patients are safer across complex care environments (Topol, E. 2019). Computer vision technologies have found increasing use in IPC protocols by monitoring behaviors and compliance in healthcare environments. For example, AI-enabled cameras can track hand hygiene adherence and environmental cleaning routines, offering objective, continuous feedback to hospital staff. A study by Bilgin et al. (2023) demonstrated the use of AI-powered video monitoring systems to enhance compliance with infection control policies, contributing to a measurable decline in cross-transmission rates.

Lastly, digital contact tracing powered by AI algorithms gained global attention during the COVID-19 pandemic. These tools helped trace exposure networks and identify potential hotpots, enabling targeted quarantining and reducing unnecessary lockdowns. In several countries, AI-enhanced contact tracing significantly curtailed transmission during critical early stages of the pandemic (Gawande et al., 2025).

3. Real-World Concerns and Ethical Implications

AI applications in infection prevention and control (IPC) raise urgent ethical challenges, like in Saudi Arabia, where technology should align with both legal norms and Islamic moral values (AlKhunaizi, 2025). These tools influence decisions in ways that demand serious reflection on autonomy, consent, privacy, fairness, and accountability.

As Rigby (2019) notes, the healthcare sector remains underprepared for the ethical complexity of AI. Guidelines lag behind, and many clinicians feel unprepared to handle these evolving dilemmas. Ethical design and implementation are not technical add-ons, they are moral imperatives (Ghaly, M., 2019).

3.1 Autonomy and Informed Consent

In AI-integrated healthcare, patients may be unaware of how their data is used or even that AI is influencing care decisions (Floridi et al., 2018; Beauchamp. 2019). Traditional, static consent models are inadequate in dynamic AI systems, which may reuse data for purposes beyond the original scope (Spencer et al., 2016). Scholars advocate for dynamic consent, a flexible, ongoing process allowing patients to modify their preferences over time (Kaye et al., 2015).

In Islamic ethics, this aligns with *ridha* (satisfaction) and *niyyah* (intentionality), stressing that any use of personal data should be both informed and voluntary (Sachedina, 2009). While emergency situations, like pandemics, may justify temporary limits on autonomy, this should be grounded in *maslahah ‘ammah* (public interest) and implemented with transparency.

The fatwa issued in 2021 by the Saudi Council of Senior Scholars affirmed digital surveillance for COVID-19 was ethically acceptable, provided it protected life and maintained dignity (General Secretariat, 2021). SDAIA’s inclusion of consent features in apps like *Tawakkalna* also reflected Islamic values such as *amanah* (trust).

3.2 Privacy and Confidentiality

AI surveillance systems depend on massive data collection, raising risks around confidentiality and data misuse. Alhusain (2025) emphasizes that privacy should remain a top ethical priority. Elgujja et al. (2024) argue that privacy breaches are only justifiable when public benefit outweighs harm, and even then, legal safeguards must be clearly defined.

Islamic teachings echo these principles. The Qur'an warns against unwarranted intrusion (*tajassus*) and emphasizes trust (*amanah*) in managing sensitive information (Qur'an 4:58). Saudi law, including Article 15 of the PDPL, reinforces that consent is required for data sharing, except in narrowly defined cases like public health emergencies (Sachedina, 2009).

Upholding privacy in AI systems requires technical and ethical safeguards, encryption, access controls, transparency, and the "privacy by design" approach (Cavoukian, 2009). These are not just legal necessities, but religious and cultural imperatives. Unauthorized data access and confidentiality breaches could lead to criminal liability, professional disciplinary measures, or tort claims (Elgujja, 2020)

3.3 Bias and Fairness

AI tools can reinforce existing healthcare disparities if not carefully designed. Models trained on skewed or incomplete data risk excluding vulnerable populations, such as migrant workers, low-income groups, or rural residents (Obermeyer et al., 2019; Mehrabi et al., 2021). It may also overlook different patterns of disease transmission prevalent in rural or resource-limited settings (Rajkomar et al., 2018).

Islamic ethics emphasizes *adl* (justice), which goes beyond equal treatment to require fairness tailored to individual needs (Sachedina, 2009). As such, developers should audit for bias, include diverse data sources, and engage marginalized communities during design and deployment (Veale & Binns, 2017; European Commission, 2021).

In Saudi Arabia's multicultural healthcare system, fairness is foundational for trust, legitimacy, and ethical alignment with Sharia principles.

3.4 Accountability and Transparency

One of the most pressing issues in AI ethics is clarity over responsibility. The "black box" nature of many AI models can create opacity that undermines trust, complicates clinical judgment, and raises legal and ethical dilemmas about who is liable when something goes wrong (Jobin et al., 2019). When an AI system makes an incorrect prediction or fails to detect an outbreak, it's often unclear who is accountable, the developer, hospital, or clinician (Rigby, 2019; Jobin et al., 2019).

Naik et al. (2022) stress that while AI itself cannot be morally responsible, those who design and use it should be. Explainable AI (XAI) systems are crucial, they provide traceable logic for decisions, helping clinicians maintain oversight and patients understand outcomes (Ghassemi et al., 2021; Gehrmann et al., 2018).

From an Islamic perspective, *mas'uliyyah* (accountability) rests on knowledge and intent. Human discretion, not automation, remains the ethical anchor for clinical decisions, especially when life, dignity, and trust are at stake (Sachedina, 2009; Ghaly, 2024).

4. Current Landscape & AI-Driven Interventions for Infection Prevention and Control

AI is rapidly transforming infection prevention and control (IPC) in Saudi Arabia, enhancing early detection of healthcare-associated infections (HAIs), improving antimicrobial stewardship, and supporting real-time surveillance. Yet, its true potential lies not just in speed or accuracy, but in aligning innovation with Saudi Arabia's ethical, legal, and cultural values (SDAIA, 2020).

The COVID-19 pandemic catalyzed this transformation. Tools like Tawakkalna and Tabaud, developed by SDAIA and the Ministry of Health (MOH), revolutionized public health surveillance. By 2020, Tawakkalna had over 22 million users, becoming the most widely used health app in the Kingdom. While effective, these tools raised concerns around transparency and data governance, especially regarding user awareness of data access and usage.

Saudi Arabia has since taken steps to address these concerns. Under SDAIA's leadership, a structured framework now governs data and AI in healthcare. Recent research confirms that AI is already delivering measurable benefits in IPC. For example, Alhusain (2025) documents improved early warning systems and compliance monitoring. Similarly, El Arab et al. (2025) report high diagnostic accuracy from explainable AI models, reinforcing clinical trust.

Notable recent use cases include the 2025 Hajj season, where Seha Virtual Hospital deployed Lunit's AI platform (Insight CXR) to screen pilgrims for respiratory diseases. The result: faster triage and improved infection control (Alquayt et al., 2025). AI-powered robots added multilingual support and outbreak predictions, while the launch of Dr. Hua, the world's first AI-run virtual clinic in Al-Ahsa, hints at future expansion into infection monitoring (Huda & Ata, 2025).

These advances reflect the Kingdom's digital health ambitions under Vision 2030. However, ethical issues remain. WHO and Saudi studies emphasize that while AI can improve outcomes during mass

gatherings like Hajj, it also demands robust governance and safeguards for privacy, consent, and data protection (World Health Organization, 2023; Alquyat, 2025).

Human factors also influence success. Jalal et al. (2025) found that although most nurses in Al-Ahsa had moderate AI knowledge, implementation was hindered by training gaps, limited institutional support, and financial constraints. Similarly, earlier research by Assiri et al. (2014) identified systemic weaknesses in IPC infrastructure, including understaffing and poor compliance systems.

These findings call for parallel investment in capacity-building, implementation support, and digital infrastructure. Saudi Arabia should benchmark against global frameworks like the WHO Global IPC Strategy (2023) and the EU AI Act (European Commission, 2024) while remaining rooted in Islamic values.

4.1 Regulatory Landscape and the Need for Sector-Specific Guidance

While the PDPL, NSDAI, and MOH Digital Health Strategy lay foundational governance for AI in healthcare, sector-specific legislation for AI in IPC is still evolving. The PDPL, effective since 2024, enforces informed consent (Article 5), data security (Article 10), and patient confidentiality, all crucial for AI-driven surveillance (SDAIA, 2021). Additionally, the Law of Practicing Healthcare Professions mandates clinicians disclose AI use and secure patient consent (MOH, 2005).

Further guardrails include the SHIEP policy (2022), which promotes secure data exchange, and SDAIA's 2023 AI Ethics Principles, which encourage fairness, transparency, and risk assessments (SDAIA, 2023). While these tools are promising, they need better alignment with the clinical specifics of IPC.

Table 1 provides a side-by-side comparison of key legal and ethical provisions in the Saudi PDPL (2021), PHL (2018), and LPHP (2005) as they apply to AI in Infection Prevention and Control

4.2 Sharia-Based Legal Principles

Saudi law integrates Islamic jurisprudence with modern regulation. Sharia principles such as *maslahah* (public interest), *la darar wa la dirar* (no harm), and *istislah* (welfare) strongly support the ethical use of AI in healthcare, provided it minimizes harm, promotes equity, and enhances public benefit (Kamali, 2008; Al-Bar & Chamsi-Pasha, 2015; Vayena et al., 2018).

The Qur'anic commands for justice (Qur'an 16:90), trust (33:72), and consultation (42:38) offer moral guidance for AI use in IPC, especially around consent, data handling, and risk governance. Religious scholars (*fuqaha*) should be engaged in shaping policy, ensuring Islamic legitimacy alongside technical soundness (Ghaly, 2018).

4.3 Legal Gaps and Challenges

Despite progress, Saudi Arabia lacks clear legal mechanisms for AI safety validation, liability assignment, and post-market oversight in IPC. Key questions remain unanswered: If an AI tool fails, who is accountable, the developer, clinician, or hospital? These ambiguities can deter adoption (Price et al., 2019).

Cross-border data sharing poses another challenge. PDPL mandates localization, but collaborative research and AI training often involve cloud-based international platforms. Balancing data sovereignty with global collaboration requires careful legal innovation (Greenleaf & Cottier, 2021).

More fundamentally, there is limited integration between Sharia-based ethics and national AI policies. This gap should be addressed for truly legitimate and culturally congruent regulation. As Elgujja et al. (2024) argue, public health justifications for data use should be clearly codified to avoid privacy overreach.

4.4 Comparative Legal Insights from Other Jurisdictions

Saudi Arabia can adapt global best practices while staying rooted in its legal and cultural context. The EU's GDPR and AI Act, and the US FDA's framework for AI-based medical devices, offer models for risk assessment, oversight, and transparency (European Commission, 2018; U.S. FDA, 2021).

Global bodies like WHO and UNESCO have issued ethical guidelines aligned with Islamic values, emphasizing fairness, inclusivity, and explainability (WHO, 2021; UNESCO, 2021). However, Saudi Arabia should localize these models, embedding Sharia ethics into AI laws to maintain cultural relevance.

Saudi Arabia has made significant strides in deploying AI for IPC. Yet, true progress will require more than innovation, it demands institutional readiness, ethical clarity, legal specificity, and public trust. Through a culturally grounded, legally robust approach, the Kingdom can lead in shaping the

ethical future of AI in healthcare. Table 2. provides a side-by-side comparison of key legal and ethical provisions in the Saudi PDPL, EU GDPR, EU AI Act, and Sharia principles as they apply to AI in Infection Prevention and Control.

5. Toward a Suitable Saudi Ethical-Legal Framework for AI in IPC

As artificial intelligence reshapes infection prevention and control (IPC), Saudi Arabia is uniquely positioned to develop an ethical-legal framework that reflects both modern governance and Islamic bioethics. Such a framework should be practical, not merely theoretical, and rooted in values like trust, accountability, and equity.

1. **Inclusive Governance Grounded in Sharia**

AI in healthcare raises complex questions about consent, data ownership, and liability. These dilemmas should be addressed through inclusive governance that brings together Sharia scholars, legal experts, and AI developers (Sachedina, 2009; Ghaly, 2021). A National Sharia-AI Bioethics Council could guide decision-making through ijtihad-based consensus and issue ethical advisories tailored to the Saudi context (Kamali, 2008; Ghaly, 2021)

2. **Regulatory Sandboxes for Safe Innovation**

To manage innovation responsibly, Saudi authorities like the SFDA and MOH could implement AI regulatory sandboxes, controlled testing environments for trialing AI tools in real-world settings. These allow for legal, technical, and ethical evaluation before widespread use, drawing on global models like those in Canada and the EU (IMDA, 2020).

3. **Transparency and Human Oversight**

AI models should be explainable and supervised. Clinicians should retain final authority, and systems should include clear liability rules in case of harm. This not only protects patients but also ensures ethical and legal accountability (Ghassemi et al., 2021; Price et al., 2019).

4. **Ethics-Focused Education**

National training programs like Saudi Arabia's "One Million AI Initiative" (SAMAI) are promising (SADAI, 2024). By embedding ethical literacy, including Sharia-informed values, into education for healthcare workers and AI professionals, the Kingdom can ensure both technical competence and

ethical awareness (SDAIA, 2024; Floridi et al., 2018; Ghassemi et al., 2021).

5. **Culturally Inclusive Implementation**

AI should serve all communities, including rural areas and non-citizens. Local engagement, through mosque campaigns, hospital focus groups, or citizen panels, can promote *shura* (consultation) and build trust. To reduce disparities, Saudi Arabia can benefit from investing in Arabic-language datasets, digital infrastructure, and equitable deployment strategies (Nuffield Council on Bioethics, 2021).

6. **Adaptation of Global Best Practices**

Saudi Arabia can learn from the EU's risk-based frameworks and Canada's algorithmic impact assessments (Government of Canada, 2020). Countries like Indonesia and the UAE show that integrating religious ethics into tech governance is both feasible and effective.

- **Privacy by Design (PbD)** offers a roadmap for embedding privacy directly into AI architecture. Its principles, such as default protection and transparency, resonate with Islamic values like *dar' al-mafāsid* (harm prevention) and *ittiqan* (excellence); (Cavoukian, n.d.).
- **Dynamic Consent** models allow patients to manage their data preferences over time. While empowering, their effectiveness depends on health literacy and user fatigue. In Saudi Arabia, a culturally sensitive, modular consent system, grounded in *rida* (voluntary consent) yet flexible enough for *maslahah* (public interest), could balance autonomy and societal need (Bruns & Winkler, 2024).

Saudi Arabia can lead the ethical use of AI in IPC by integrating Islamic ethics, practical regulation, and global models. A balanced, inclusive, and actionable framework, grounded in local values yet globally informed, can ensure AI enhances public health without compromising human dignity or religious integrity. Table 3 presents a contextualized analysis of potential benefits and risks associated with specific AI applications in Infection Prevention and Control (IPC) within Saudi Arabia. It considers the Kingdom's demographic composition, healthcare infrastructure, and socio-cultural factors.

7. Recommendations for Future Policy Directions

To ensure the ethical and effective integration of artificial intelligence into infection prevention and

control (IPC) within Saudi Arabia's healthcare system, the following actionable recommendations are proposed:

1. **Strengthen Legal and Ethical Oversight**

Saudi regulatory bodies, such as SDAIA and the Ministry of Health, can reinforce frameworks like the Personal Data Protection Law (PDPL) with clear, enforceable guidelines specific to AI applications in healthcare. These should address data ownership, consent, liability, and cross-border data transfers.

2. **Embed Islamic Bioethics into Policy Development**

AI governance in IPC should reflect Islamic ethical principles, *maslahah* (public interest), *adl* (justice), and *amanah* (trust). Integrating these values into policy design will ensure ethical alignment with Saudi society and enhance public trust.

3. **Enhance Transparency and Explainability**

Developers and health institutions should adopt AI models that are auditable and explainable. Transparent algorithms help ensure accountability and enable clinicians and patients to understand how decisions are made.

4. **Mandate Inclusive and Representative Datasets**

To minimize bias, AI systems should be trained on diverse and demographically representative data from Saudi populations. National health databases should adopt standardized protocols to support safe, privacy-conscious data sharing.

5. **Invest in Capacity Building and Ethics Training**

Medical professionals, data scientists, and AI developers should receive targeted training in AI ethics, Sharia-informed bioethics, and legal compliance. Universities and institutions should integrate such curricula into medical and technical education.

6. **Establish Multidisciplinary AI Ethics Committees**

Hospitals and health ministries should create ethics committees composed of clinicians, jurists, AI experts, and religious scholars to evaluate the deployment of AI in IPC, ensuring case-by-case scrutiny of ethical dilemmas.

7. **Promote Public Awareness and Patient Engagement**

Patients should be informed of how AI technologies impact their care. Public education campaigns and consent protocols should be transparent, accessible, and culturally sensitive to foster patient agency.

8. **Foster Cross-Sector Collaboration and Innovation**

Effective AI integration requires collaboration between public health agencies, academic researchers,

the private sector, and religious authorities. Cross-sectoral partnerships can generate context-aware, scalable AI solutions for IPC.

9. Pilot Ethical AI Frameworks Before National Rollout

New AI systems and policies should undergo controlled, small-scale pilot testing in selected hospitals or regions. Feedback from these pilots can guide adaptive policy refinement and risk mitigation

8. Conclusion

Artificial intelligence holds transformative potential in infection prevention and control, offering faster detection, smarter surveillance, and more responsive healthcare systems. Yet, as this technology becomes more embedded in clinical and public health settings, it brings ethical and legal complexities that should not be overlooked.

In Saudi Arabia, navigating these challenges may require a dual commitment: to global best practices in digital health and to the country's ethical and legal foundations rooted in Islamic bioethics. Principles such as maslahah (public interest), adl (justice), and amanah (trust) provide a meaningful lens through which AI can be responsibly developed and deployed.

This article has proposed a culturally grounded framework for AI governance in IPC**,** one that respects patient rights, promotes fairness, ensures accountability, and upholds public trust. Aligning AI innovation with both statutory law, such as the PDPL, and religious-ethical values is not only possible**,** it is essential.

As Saudi Arabia advances its Vision 2030 agenda, it has the opportunity to lead by example: demonstrating that innovation need not come at the cost of ethics, and that technology can thrive within a framework of cultural integrity and moral clarity.

9. Tables and Figures

Table 1.: Comparative Summary of Relevant Saudi Arabian Laws

Legal Domain	Personal Data Protection Law (PDPL, 2021)	Public Health Law (Royal Decree No. M/47, 2018)	Law of Practicing Health Professions (Royal Decree No. M/59, 2005)
Purpose	To regulate the collection,	To safeguard public health and control	Ensures ethical conduct and protection of patients

	processing, and protection of personal data	communicable diseases	by healthcare workers through established duties of care.
Scope	Applies to all entities handling personal data in the Kingdom	Applies to all individuals, healthcare facilities, and public health authorities	Applies to all licensed health practitioners across public and private sectors within the Kingdom
Consent Requirement	Requires explicit, informed consent for most data uses	Allows data processing without consent during public health emergencies	Requires patient consent before medical intervention (Article 19), except in emergencies.
Data Minimization & Purpose Limitation	Mandates minimal use of data relevant to declared purposes	Allows broad data use for epidemiological tracking and outbreak response	Mandates care proportional to clinical need, prohibits unnecessary procedures or information sharing.
Surveillance and Contact Tracing	Permits only under lawful, proportionate, and necessary conditions	Empowers MOH to implement digital surveillance for outbreak control	Does not directly regulate surveillance but supports obligation to maintain confidentiality.
Data Subject Rights	Includes rights to access, correct, and delete personal data	Public health priority may override some individual rights temporarily	Affirms patient rights to safety, informed care, and refusal of treatment under lawful conditions.
Accountability and Enforcement	Supervised by SDAIA with administrative penalties for violations	MOH and public health authorities can enforce compliance through legal sanctions	Enforced by professional licensing bodies; violations may lead to disciplinary or legal actions.

Alignment with Islamic Ethics	Emphasizes	Supported by	Aligns with Islamic principles of

Table 2. Comparative Analysis Saudi PPDL EU GDPR, EU AI Act, and Sharia Principles

The table provides a side-by-side comparison of key legal and ethical provisions in the Saudi PDPL, EU GDPR, EU AI Act, and Sharia principles as they apply to AI in Infection Prevention and Control

Feature	Saudi PDPL	EU GDPR	EU AI Act	Sharia Principles
Scope	Applies to all entities handling personal data in the Kingdom	Applies to all data controllers/processors in EU or processing EU citizens' data	Applies to AI systems placed on the EU market or used in EU	Applies to all acts in life, including tech governance
Consent Requirement	Explicit informed consent for most uses; exceptions for emergencies	Freely given, informed, specific consent; strict conditions for exceptions	Depends on AI risk category; high-risk systems need explicit consent alignment	Consent (rida) essential except in public interest (maslahah) emergencies
Data Minimization & Purpose Limitation	Minimal data use relevant to declared purposes	Purpose limitation & data minimization explicitly required	Risk-based constraints for AI data usage	No harm principle (la darar) requires minimal necessary data use
Surveillance & Contact Tracing	Permitted under lawful, proportionate, necessary conditions	Strict proportionality and necessity requirements	Permits only under high-risk category governance	Permitted if protects life, dignity, and public interest
Data Subject Rights	Rights to access, correct, delete personal data	Rights to access, rectify, erase, portability, restrict processing	Transparency & human oversight rights	Right to privacy, fairness, and consultation (shura)
Accountability & Enforcement	Supervised by SDAIA with penalties for violations	National DPAs enforce with heavy fines	Notified bodies and national authorities enforce	Accountability (masâ'uliyyah) before God and community
Bias & Fairness Requirements	Not explicitly mandated but aligned with Islamic justice (adl)	Fairness & non-discrimination embedded	Bias assessment mandatory for high-risk AI	Justice (adl) requires fairness tailored to needs
Cultural/Ethical Integration	Grounded in Islamic ethics (maslahah, amanah)	Secular human rights principles	Secular rights, diversity, inclusivity principles	Rooted in Qur'an, Sunnah, juristic consensus

Table 3. Potential Benefits and Barriers of each AI Concept

The table below presents a contextualized analysis of potential benefits and risks associated with specific AI applications in Infection Prevention and Control (IPC) within Saudi Arabia. It considers the Kingdom's demographic composition, healthcare infrastructure, and socio-cultural factors

AI Application	Potential Benefits	Potential Risks / Barriers
Dynamic Consent Systems	Enhances patient autonomy; allows flexible data use permissions; aligns with Islamic values of rida (voluntary consent).	Requires high digital literacy; rural and older populations may struggle; costly implementation and maintenance.
Bias and Fairness Audits	Promotes equity, reduces algorithmic discrimination, builds trust across diverse population groups.	Limited local demographic data; incomplete health records, especially for migrant workers; risk of reinforcing systemic inequities.
Predictive Outbreak Modelling	Improves early outbreak detection; supports proactive interventions; optimizes resource allocation.	Accuracy depends on reliable real-time data; risk of false positives/negatives; potential public panic if misinterpreted.
AI-Powered Contact Tracing	Speeds identification of exposure networks; reduces unnecessary quarantines; enhances public health response.	Raises privacy concerns; may face resistance due to cultural views on surveillance; needs robust data security.
Automated Hygiene Monitoring	Increases compliance with hygiene protocols; reduces healthcare-associated infections; lowers operational costs.	High setup costs; technical malfunctions could disrupt IPC workflows; possible resistance from staff due to monitoring discomfort.

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