Tawhidic HMB Framework Safeguarding Kinship and Nurturing Life: A Tawhidic Epistemology Framework for Digitalised Shariah-Compliant Human Milk Banking

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DOI: https://dx.doi.org/10.47772/IJRISS.2025.91200326

Received: 28 December 2025; Accepted: 02 January 2026; Published: 17 January 2026

ABSTRACT

Human milk banking (HMB) is widely recognised as a critical public health intervention that improves survival and health outcomes among preterm and medically vulnerable infants. However, in Muslim-majority contexts, the implementation of HMB remains ethically complex due to concerns surrounding raḍāʿah (milk kinship), lineage integrity, and long-term social implications. While existing studies have examined medical benefits, community acceptance, and isolated digital solutions, the literature remains fragmented, with limited integration between Islamic ethical principles and contemporary digital health system design.

This study conducts a systematic literature review of sixteen peer-reviewed publications published between 2018 and 2025 to examine how Shariah considerations, technological maturity, and governance mechanisms are addressed within existing HMB models. Using a dual-axis analytical framework that maps digital system maturity against the depth of Shariah integration, the review reveals a significant research gap. No existing model simultaneously demonstrates robust digital traceability and comprehensive Islamic ethical governance. Most studies emphasise either jurisprudential clarification without operational systems or technological innovation without lineage-protective safeguards.

Guided by Tawhidic epistemology as a holistic worldview that integrates ethical values, knowledge production, and practical implementation, this paper proposes a digitalised Shariah-compliant human milk banking framework modelled on the Halimatussaadia Mothers' Milk Centre (HMMC) in Malaysia. The proposed framework embeds identity governance, digital consent management, kinship alert mechanisms, and traceable oversight structures aligned with maqāṣid al-sharīʿah, particularly the preservation of life (ḥifẓ al-nafs) and lineage (ḥifẓ al-nasab).

The study contributes theoretically by extending Islamic bioethics into socio-technical system design, methodologically by demonstrating the value of epistemologically informed review analysis, and practically by offering a scalable governance-oriented framework for ethically grounded digital health innovation in Muslim-majority settings.

Keywords: Human milk banking; Tawhidic epistemology; Shariah compliance; Digital traceability; Milk kinship

INTRODUCTION

Human milk is widely recognised as the most suitable and complete source of nutrition for infants, offering immunological protection and long-term developmental benefits, particularly for preterm and medically vulnerable newborns. When a mother is unable to breastfeed due to medical or physiological reasons, donor human milk is recommended as the safest alternative. International organisations such as the World Health Organization and UNICEF consistently emphasise donor human milk as a key strategy for improving neonatal survival and health outcomes (UNICEF, 2021; World Health Organization, 2023). Consequently, human milk banking (HMB) has become an established component of neonatal care in many countries, with more than 700 milk banks operating globally (Israel-Ballard et al., 2024; PATH, 2019).

However, the implementation of HMB in Muslim-majority contexts presents challenges that extend beyond clinical effectiveness. In Islam, milk sharing establishes raḍāʿah (milk kinship), a legally recognised relationship with lasting implications for lineage, marriage permissibility, and social responsibility. Milk kinship is not symbolic or temporary; it carries specific legal consequences comparable to biological kinship in defined contexts. Safeguarding lineage (ḥifẓ al-nasab) is therefore a core objective within maqāṣid al-sharīʿah (Muda & Nazri, 2020). Any practice of donor milk provision that does not adequately document donor–recipient relationships risks violating this fundamental ethical principle, regardless of its medical benefits.

Within this ethical context, global human milk banking systems offer valuable clinical and operational insights but remain insufficient when applied without contextual adaptation. Established HMB systems have demonstrated substantial improvements in neonatal health outcomes through donor screening, pasteurisation, and structured distribution mechanisms (PATH, 2022). Countries with mature milk bank networks, including Brazil and parts of Europe, provide important operational references; however, these models were developed within cultural and ethical environments that do not account for milk kinship considerations central to Muslim societies. Direct adoption of such models without appropriate governance mechanisms therefore presents challenges in Muslim-majority settings.

In practice, these ethical and governance limitations are reflected in community responses to donor human milk services. Across Muslim-majority and Muslim-populated contexts, caregivers recognise the medical value of donor human milk while simultaneously expressing concern over donor anonymity, incomplete documentation, and uncertainty surrounding milk kinship relationships (Ramachandran et al., 2024; Hosseinzadeh et al., 2023; Pramono & Hikmawati, 2024; Obeng et al., 2023). These concerns indicate that acceptance of HMB is shaped not solely by clinical outcomes, but by trust in governance mechanisms capable of safeguarding lineage and ensuring long-term accountability.

At the same time, healthcare systems are increasingly shaped by digitalisation. Secure digital record systems and traceability architectures are being adopted to enhance transparency, accountability, and ethical governance of sensitive medical data. Blockchain-based approaches, in particular, have demonstrated value in strengthening data integrity and auditability in healthcare information systems (Liu et al., 2024). In the context of breastfeeding support and milk sharing, digital applications have been proposed to improve coordination and monitoring; however, most existing solutions lack explicit Shariah integration or remain conceptual without institutional validation (Razak et al., 2023; Zahar et al., 2019).

A closer examination of the literature reveals persistent fragmentation. Jurisprudential studies clarify permissibility and ethical principles but rarely extend into operational or system-level design (Muda & Nazri, 2020; Gribble et al., 2025). Conversely, technologically oriented studies demonstrate innovation without adequate engagement with Shariah governance or lineage protection (Razak et al., 2023; Liu et al., 2024). Consequently, no existing model demonstrates how Shariah principles—particularly the preservation of life (ḥifẓ al-nafs) and lineage (ḥifẓ al-nasab)—can be operationalised within a fully functional digital human milk banking system.

In response, this paper adopts Tawhidic epistemology as a guiding worldview that integrates ethics, knowledge, and practice. Tawhidic epistemology provides a holistic foundation for embedding ethical objectives directly into system logic and governance structures. Accordingly, this study proposes a digitalised Shariah-compliant human milk banking framework, using the Halimatussaadia Mothers' Milk Centre (HMMC) in Malaysia as a conceptual model.

METHODOLOGY

This study adopts a systematic literature review (SLR) approach to examine existing research on human milk banking (HMB), with specific attention to Shariah compliance, milk kinship governance, and digital traceability systems. The SLR method was selected as it allows for a structured and transparent synthesis of existing knowledge, making it suitable for identifying conceptual gaps, dominant themes, and areas requiring further theoretical and practical development. Given the fragmented nature of prior studies across medical, ethical, and technological domains, a systematic review was considered the most appropriate approach to consolidate and critically analyse the literature.

Review Design and Search Strategy

The review was conducted in accordance with the PRISMA 2020 guidelines, ensuring transparency and methodological rigour throughout the selection and screening process. Three major academic databases—Scopus, Web of Science, and Google Scholar—were used to capture a broad yet relevant body of literature. These databases were selected due to their extensive coverage of peer-reviewed publications across health sciences, social sciences, and interdisciplinary research.

A structured search strategy was developed using Boolean operators to combine four key concept clusters:

(i) human milk banking and donor human milk,

(ii) Shariah, Islamic ethics, and milk kinship,

(iii) digital health systems and traceability, and

(iv) epistemological or ethical frameworks.

The search was limited to studies published between 2018 and 2025 to ensure that findings reflected current practices, technological developments, and contemporary ethical discussions.

Inclusion and Exclusion Criteria

Clear inclusion and exclusion criteria were applied to ensure relevance and quality. Studies were included if they were peer-reviewed, written in English, and addressed at least one of the following dimensions: human milk banking practices, Islamic or Shariah-related considerations, community perceptions, or digital and traceability systems related to milk sharing or healthcare governance. Both empirical and conceptual studies were considered to allow for a comprehensive understanding of the field.

Studies were excluded if they focused solely on clinical or nutritional outcomes without reference to governance, ethics, or systems; if they addressed milk sharing outside a healthcare or institutional context without analytical relevance; or if they consisted of non-scholarly sources such as opinion pieces, news articles, or informal reports. This filtering ensured that the review remained focused on studies capable of informing an integrated ethical and system-level framework.

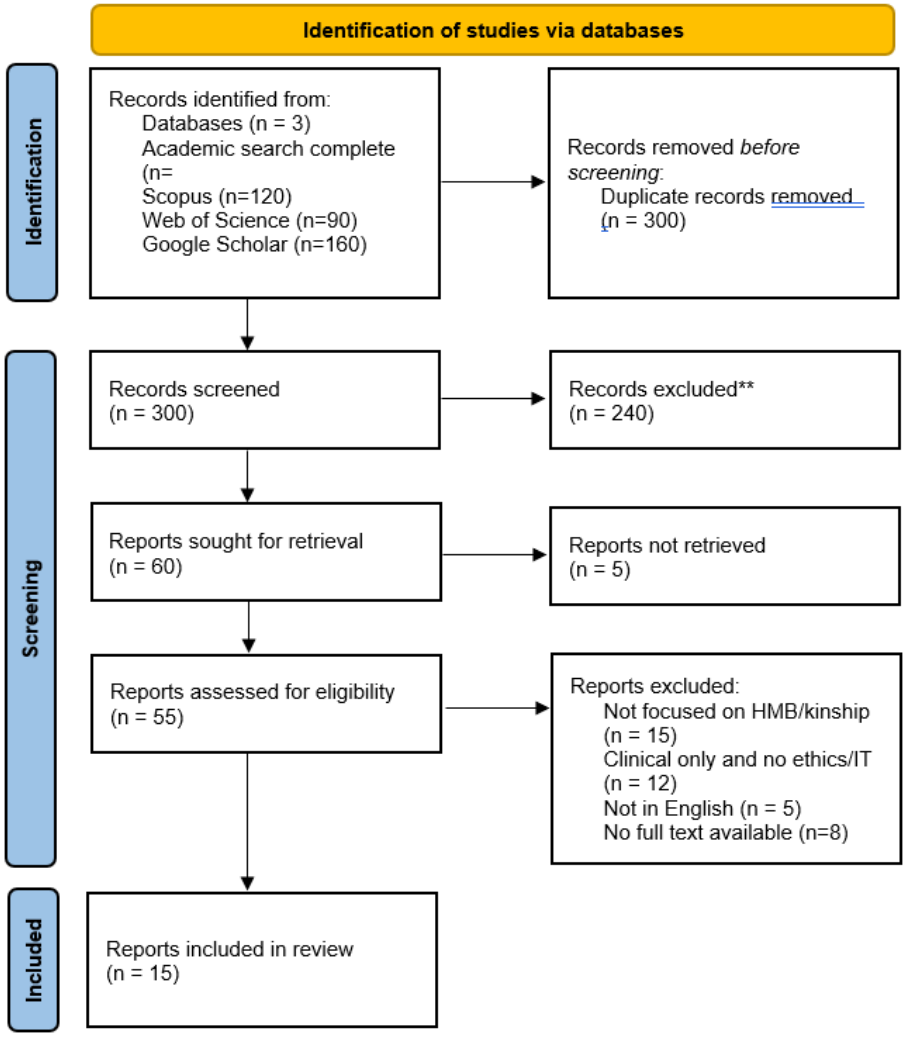
Screening and Selection Process

The initial database search yielded a larger pool of records, which were first screened based on titles and abstracts to remove duplicates and clearly irrelevant studies. The remaining articles underwent full-text screening to assess

eligibility against the predefined inclusion criteria. Following this process, sixteen studies were identified as meeting all criteria and were included in the final review. The selection process is summarised using a PRISMA flow diagram to enhance transparency and replicability.

Figure 1 presents the PRISMA flow diagram outlining the study identification, screening, and inclusion process.

Figure 1. PRISMA 2020 flow diagram for the systematic literature review on Shariah-compliant human milk banking (2018–2025).



Data Extraction and Analytical Approach

Data were systematically extracted from each included study, focusing on publication context, study design, geographical setting, main research focus, level of Shariah or ethical integration, and degree of digital or operational maturity. Rather than treating these dimensions in isolation, the analysis sought to understand how ethical considerations and technological approaches intersected within existing HMB research.

To support this analysis, the reviewed studies were mapped using a dual-axis analytical framework, where one axis represented the level of digital system maturity and the other represented the depth of Shariah or Tawhidic integration. This approach enabled the identification of patterns, clusters, and gaps across the literature, particularly highlighting areas where ethical depth or technological capability was underdeveloped.

The characteristics of the reviewed studies are summarised in Table 1.

Synthesis and Framework Development

The final stage of analysis involved synthesising the reviewed findings to inform the development of a conceptual framework for a digitalised Shariah-compliant human milk banking system. Guided by Tawhidic epistemology, the synthesis emphasised coherence between ethical objectives, knowledge structures, and practical system design. Rather than proposing a technical solution in isolation, the framework development focused on governance elements such as identity verification, consent management, kinship documentation, and traceability mechanisms.

This methodological approach supports the study's aim of bridging ethical principles and digital innovation, and provides a structured foundation for proposing the Halimatussaadia Mothers' Milk Centre (HMMC) as a model for ethically governed, digitally enabled human milk banking in Muslim-majority contexts.

Table 1. Characteristics of the Sixteen Studies Included in the Systematic Literature Review

No.	Author(s) & Year	Country	Study Design	Main Focus	Shariah / Tawhidic Integration	Digital / Operational Maturity
1	Gribble et al. (2025)	Multi-country	Qualitative	Islamic pathways for donor milk	High	Low
2	Hosseinzadeh et al. (2023)	Iran	Survey	Mothers' knowledge & attitudes	Medium	Low
3	Israel-Ballard et al. (2023)	Global	Global Review	Global status of HMB, models, safety processes	Low	High (operational & digital documentation)
4	Jackson & Obeng (2022)	USA	Mixed Methods	HMB use during formula shortage	Low	Medium
5	Muda & Nazri (2020)	Malaysia	Conceptual	Islamic milk kinship jurisprudence	High	Low
6	Obeng et al. (2023)	Ghana	Survey	Community perceptions	Low	Low
7	Obeng-Gyasi et al. (2025)	Africa	Review	HMB challenges in Africa	Low	Low
8	PATH (2019)	Global	Technical Report	Global HMB models & operations	Low	Medium
9	Pramono & Hikmawati (2024)	Indonesia	Media Content Analysis	Sociocultural discourse on HMB	Low	Low

10	Pramono & Hikmawati (2024)	Indonesia	Media Study	Public narratives on HMB	Low	Low
11	Ramachandran et al. (2024)	Malaysia	Survey	Acceptance of HMB	Medium	Low
12	Razak et al. (2023)	Malaysia	Scoping Review	Technology for lactation support	Low	High
13	UNICEF (2021)	Global	Report	Donor milk & neonatal survival	Low	Low
14	WHO (2023)	Global	Guideline	Feeding of preterm infants	Low	Low
15	Liu et al. (2024)	Global	Systems Review	Digital traceability & blockchain	Low	High
16	Zahar et al. (2019)	Malaysia	Prototype Design	Shariah-compliant milk sharing app	Medium	Medium

RESULTS AND DISCUSSION

This section presents and discusses the findings of the systematic literature review by examining patterns, gaps, and implications emerging from the selected studies. Rather than reporting results in isolation, the discussion is integrated to allow a coherent interpretation of how ethical considerations, community perspectives, and digital system development intersect within current human milk banking (HMB) research.

Overview of Reviewed Studies

A total of sixteen studies published between 2018 and 2025 met the inclusion criteria and were included in the final analysis. These studies encompassed a range of geographical contexts, including Malaysia, Indonesia, Iran, Ghana, and broader global settings. Methodologically, the reviewed literature consisted of surveys, qualitative studies, conceptual analyses, media content analyses, scoping reviews, and global policy reports. This diversity reflects the interdisciplinary nature of HMB research, which spans healthcare, ethics, social science, and information systems.

Despite this diversity, the studies shared a common limitation: most addressed only one or two dimensions of human milk banking, such as medical outcomes, ethical permissibility, or social acceptance, without integrating these aspects into a unified operational or governance framework. This fragmentation became increasingly apparent during the synthesis stage of the review.

The reviewed literature highlights a recurring tension between medical effectiveness, ethical governance, and technological capability within existing human milk banking research. While global HMB systems have demonstrated success in improving neonatal outcomes, their governance structures were not designed to address milk kinship requirements. Studies conducted in Malaysia, Iran, Indonesia, and Ghana consistently report that community acceptance of donor milk is conditional upon the availability of transparent mechanisms for identifying donors, recording recipients, and preserving kinship information over time (Ramachandran et al., 2024; Hosseinzadeh et al., 2023; Pramono & Hikmawati, 2024; Obeng et al., 2023).

From a Shariah perspective, milk kinship constitutes a legally recognised relationship with enduring implications for lineage, marriage permissibility, and social responsibility. Jurisprudential analyses affirm that milk donation is permissible when it serves to preserve infant life; however, they emphasise that accurate kinship documentation and traceability are indispensable governance requirements rather than optional administrative

practices (Muda & Nazri, 2020; Gribble et al., 2025). In the absence of such governance structures, even medically beneficial milk banking initiatives may face public hesitation and reduced trust.

At the same time, digital transformation in healthcare has introduced new opportunities to enhance accountability, transparency, and traceability. Studies examining digital identity systems, blockchain-based records, and healthcare traceability tools demonstrate their growing role in protecting patient rights and supporting ethical decision-making (Liu et al., 2024). In the specific context of breastfeeding and milk sharing, digital applications have been proposed to support coordination and monitoring; however, most existing solutions lack explicit Shariah integration or remain at a conceptual stage without institutional validation (Razak et al., 2023; Zahar et al., 2019).

Taken together, these findings reinforce the absence of an integrated approach that simultaneously addresses Shariah governance and digital system maturity. This gap underpins the need for a framework capable of embedding ethical objectives—particularly the preservation of life (ḥifẓ al-nafs) and lineage (ḥifẓ al-nasab)—directly into the design and governance of digital human milk banking systems.

Shariah Compliance and Milk Kinship Considerations

Several studies placed strong emphasis on Shariah perspectives related to milk donation and milk kinship. Islamic scholarship affirms the permissibility of milk donation to preserve life, while emphasising that kinship documentation is a mandatory governance requirement (Muda & Nazri, 2020; Gribble et al., 2025). These studies highlight that milk kinship is not merely a cultural concern, but a legally binding relationship with long-term implications.

However, while these works offer important ethical clarity, they largely remain at a conceptual level. Practical questions regarding how kinship information should be recorded, stored, retrieved, and governed within an institutional setting are seldom addressed. As a result, the ethical guidance provided by these studies, although necessary, is insufficient on its own to support the operationalisation of Shariah-compliant human milk banking.

Community Perceptions and Conditional Acceptance

Empirical studies focusing on community perceptions reveal a consistent pattern across different cultural settings. Research conducted in Malaysia, Iran, Indonesia, and Ghana indicates that mothers and families generally recognise the health benefits of donor human milk and express openness toward human milk banking (HMB) services (Ramachandran et al., 2024; Hosseinzadeh et al., 2023; Pramono & Hikmawati, 2024; Obeng et al., 2023). However, this acceptance is not unconditional.

Across these contexts, acceptance of HMB is strongly dependent on the availability of transparent donor–recipient identification and reliable mechanisms for recording and retrieving milk kinship information. Respondents repeatedly emphasised concerns related to donor anonymity, lack of accessible records, and uncertainty regarding future kinship implications. These concerns suggest that trust in HMB systems is shaped more by governance quality than by medical effectiveness alone. In Muslim contexts in particular, the absence of reliable kinship documentation mechanisms can undermine public confidence, even when the religious permissibility of milk donation is acknowledged in principle.

Digitalisation and Traceability in Existing HMB Research

A smaller subset of the reviewed literature examined the role of digital technologies in supporting breastfeeding practices, milk sharing, and healthcare traceability. These studies reflect growing interest in digital tools such as mobile applications and electronic record systems to improve coordination, monitoring, and accountability within milk exchange and healthcare processes (Razak et al., 2023). From a technological perspective, this body of work demonstrates relatively high system maturity and innovation potential.

Blockchain-based healthcare record systems, in particular, have been shown to strengthen traceability, transparency, and governance of sensitive medical data through improved data integrity and auditability (Liu et

al., 2024). Such capabilities are highly relevant to human milk banking, where accurate record-keeping and long-term traceability are essential. However, despite this technological potential, integration with Shariah governance remains limited.

Most digital-focused studies do not explicitly address milk kinship, religious consent structures, or Shariah-compliant governance requirements. Even when Shariah considerations are acknowledged, proposed systems often remain at a conceptual or prototype stage without validation in real institutional settings (Zahar et al., 2019). This indicates that technological capability alone is insufficient to resolve ethical concerns unless it is guided by a coherent moral and governance framework capable of embedding lineage protection and accountability into system design.

Mapping the Literature Gap: Digital Maturity and Shariah Integration

To synthesise the reviewed findings, the selected studies were mapped along two analytical dimensions: the level of digital system maturity and the depth of Shariah or Tawhidic integration. This mapping approach was used to examine how existing research positions itself in relation to both technological development and ethical governance, rather than treating these dimensions in isolation.

The analysis reveals a clear clustering pattern. Most studies are positioned either within the high-Shariah–low-digital category or the high-digital–low-Shariah category. Studies grounded in Islamic jurisprudence demonstrate strong ethical and normative grounding but offer limited operational or technological development. In contrast, digitally oriented studies exhibit higher levels of system maturity and innovation potential, yet provide minimal engagement with Shariah governance, milk kinship, or lineage protection.

Importantly, no reviewed study occupies the quadrant representing both high digital maturity and high Shariah integration. This unoccupied space highlights a critical gap in the literature and indicates that ethical and technological challenges in human milk banking are typically addressed separately rather than through an integrated approach. The absence of such integrative models underscores the need for a framework capable of embedding Shariah governance directly into digital system design.

Figure 2 maps the reviewed studies according to their level of digital system maturity and depth of Shariah integration.

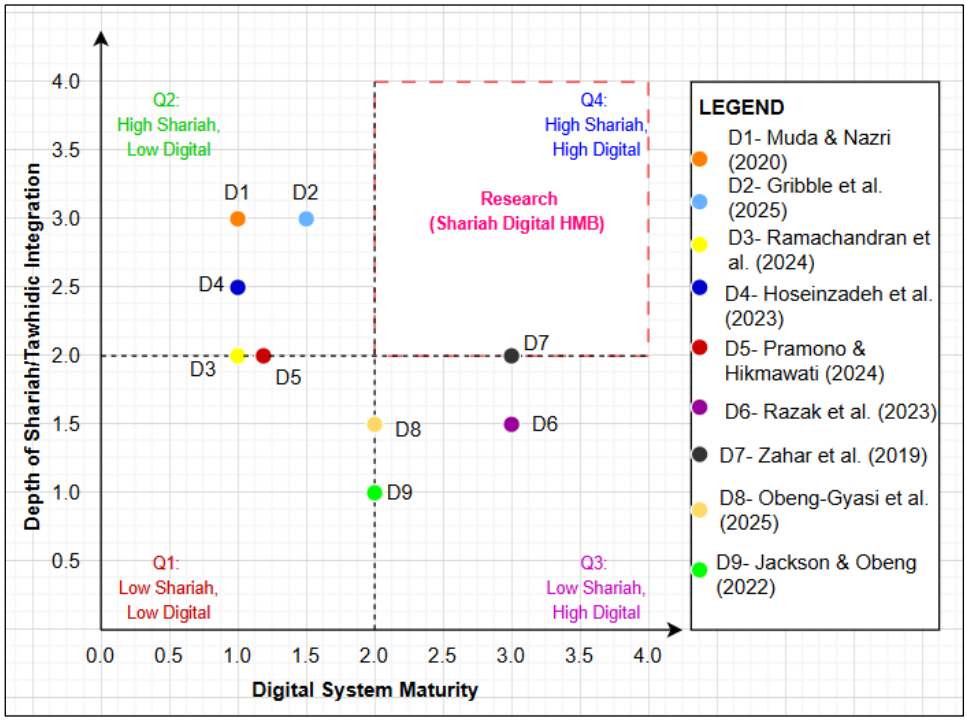


Figure 2. Literature gap map of human milk banking research, plotted along axes of digital system maturity (X-axis) and depth of Shariah/Tawhidic integration (Y-axis).

Implications for Framework Development

The identification of an unoccupied high-Shariah and high-digital quadrant carries important implications for the development of future human milk banking models. It indicates that current approaches tend to prioritise either ethical legitimacy without operational scalability or technological advancement without adequate Shariah governance. As a result, ethical concerns related to milk kinship and lineage protection remain unresolved when technology is adopted, while operational inefficiencies persist when ethical discussions are not translated into system design.

This finding suggests that effective Shariah-compliant human milk banking cannot be achieved through incremental improvements to existing models alone. Instead, there is a need for an integrated, governance-oriented framework that embeds Shariah principles directly into digital system architecture. Such a framework must move beyond conceptual ethical endorsement to incorporate practical mechanisms for traceability, consent management, kinship documentation, and long-term accountability.

The implications of this gap extend beyond technical design to institutional governance. Without a coherent framework guiding system development, healthcare institutions risk implementing digital solutions that are efficient yet ethically insufficient, or ethically sound practices that lack operational sustainability. Addressing this gap therefore requires a holistic approach in which ethical objectives—particularly the preservation of life (ḥifẓ al-nafs) and lineage (ḥifẓ al-nasab)—are operationalised through digitally enabled governance structures.

These implications directly inform the proposed framework in this study, which seeks to integrate Tawhidic epistemology with digital traceability to support ethically grounded, socially trusted, and operationally viable human milk banking systems in Muslim-majority contexts.

CONCLUSION

Human milk banking has become an increasingly important component of neonatal healthcare, particularly for preterm and medically vulnerable infants. While its medical benefits are well established, this study demonstrates that the implementation of human milk banking in Muslim-majority contexts involves ethical and governance challenges that cannot be addressed through clinical effectiveness alone. Concerns related to milk kinship, lineage protection, and long-term social implications continue to influence community acceptance and institutional decision-making.

The findings of this study indicate that existing research on human milk banking remains fragmented. Studies grounded in Islamic jurisprudence provide essential ethical guidance but rarely translate these principles into operational or system-level design. In contrast, digitally oriented studies demonstrate technological innovation and system maturity without sufficiently engaging with Shariah governance or lineage protection. As a result, no existing model fully integrates robust digital traceability with comprehensive Shariah compliance within an institutional milk banking context.

By synthesising findings from a systematic literature review and applying a Tawhidic epistemological lens, this paper addresses this gap by proposing a digitalised Shariah-compliant human milk banking framework modelled on the Halimatussaadia Mothers' Milk Centre (HMMC). Tawhidic epistemology provides a holistic foundation that aligns ethical objectives, knowledge generation, and practical implementation. Within the proposed framework, the preservation of life (ḥifẓ al-nafs) and the safeguarding of lineage (ḥifẓ al-nasab) are embedded directly into governance structures and digital system architecture, rather than treated as external ethical considerations.

The contributions of this study are threefold. Theoretically, it extends Islamic bioethical discourse by demonstrating how Tawhidic epistemology can function as a socio-technical governance framework for digital health systems. Methodologically, it illustrates the value of systematic literature review combined with analytical mapping to identify epistemological and operational gaps in interdisciplinary research. Practically, it offers a scalable and context-sensitive framework that can guide healthcare institutions, policymakers, and system designers in developing ethically grounded and digitally enabled human milk banking services.

Although this study is conceptual in nature, it provides a strong foundation for future empirical work. Subsequent research may focus on validating the proposed framework through case studies, stakeholder engagement, and prototype implementation within hospital settings. By advancing an integrated ethical and digital approach, this study contributes to ongoing efforts to strengthen trust, governance, and sustainability in human milk banking, particularly within Muslim-majority societies seeking solutions that are both medically effective and ethically accountable.

ACKNOWLEDGEMENT

This work was supported by the Centre for Postgraduate Studies, International Islamic University Malaysia, through the opportunity to present at the Postgraduate IIUM Colloquium 2025. The author gratefully acknowledges her supervisors for their guidance, and the Halimatussaadia Mothers' Milk Centre (HMMC) for its invaluable support. Deepest thanks are also extended to her children, whose inspiration remains a constant source of strength.

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