Perceptions and Challenges of Artificial Intelligence Adoption in Healthcare Crisis Management: Insights from Hassan II regional hospital in Dakhla

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Abstract:

Introduction

Artificial intelligence (AI) accelerates data processing, supports clinical decision-making, and optimizes resource allocation—capabilities that are especially critical during health crises. However, in Morocco, particularly in underserved regions like Dakhla, limited data exist on how frontline healthcare professionals perceive AI's role in crisis response. This study explores the views of healthcare workers at Hassan II Regional Hospital in Dakhla to identify opportunities and barriers to AI adoption in emergency care.

Methods and Materials

We conducted a cross-sectional quantitative survey involving 34 healthcare professionals—including physicians, nurses, and aides—from the hospital's emergency department. The structured questionnaire, developed from recent literature, assessed participants' awareness of AI, perceptions of its benefits, trust in autonomous decision-making, ethical concerns, and willingness to use AI-based tools. We collected data anonymously, with informed consent, and analyzed responses using descriptive statistics in SPSS Software.

Results

The sample had a balanced gender distribution and a young age profile (mean age: 28.2). Most respondents (72%) were aware of AI in healthcare, and 77.8% believed it could improve care quality. Key expected benefits included improved diagnostic accuracy, optimized patient record management, and personalized treatments. However, 52.8% rejected AI-generated diagnoses or treatments without physician validation, highlighting limited trust in autonomous tools. Respondents were more receptive to AI in monitoring applications (55.6%). Their main concerns centered on diagnostic errors (44.4%), lack of algorithmic transparency (25%), and privacy risks (19.4%). They strongly supported human oversight (38.9%) and strict regulation (33.3%).

Conclusion

Overall, healthcare professionals see AI as a valuable support for crisis response but insist on strong ethical frameworks, medical supervision, and increased trust-building measures for future integration.

Keywords: *Artificial Intelligence, Healthcare Crisis, Perception, Ethics, Emergency Medicine, Digital Health*

Introduction

Global healthcare systems face unprecedented challenges in managing health crises, from pandemic outbreaks to natural disasters and complex emergencies. The COVID-19 pandemic has particularly highlighted the critical gaps in traditional crisis response mechanisms, revealing the urgent need for innovative technological solutions to enhance surveillance, decision-making, and resource allocation during health emergencies [1][2]. Artificial intelligence (AI) has emerged as a transformative force capable of addressing these challenges through rapid data analysis, predictive modeling, and automated decision support systems [3][4].

The use of AI in healthcare crisis management shifts emergency response from reactive to proactive. Emerging technologies including machine learning, deep learning, and natural language processing are promising for epidemiological modeling, early warning systems, and real-time surveillance [5][6]. The World Health Organization's All-Hazard Information Management (AIM) Toolkit uses generative AI to cut response document creation time from weeks to minutes [7]. Comprehensive studies have proven that AI-enabled emergency response systems improve prediction accuracy, automate danger identification, and optimize resource allocation, speeding response times and situational awareness [8].

AI for healthcare crisis management is difficult to implement, especially in resource-constrained and impoverished countries. AI implementation is hindered by infrastructure issues including intermittent internet, electricity, and digital literacy [9][10]. The digital gap impacts healthcare delivery in Africa, where 40% of the population lacks internet access compared to 88% in North America and Europe [11]. Morocco ranks fourth in Africa for digital access, yet 270 rural communities face urgent medical isolation [12][13].

Healthcare crisis management AI adoption has ethical concerns that must be considered. Healthcare professionals and legislators prioritize openness, accountability, and human supervision [14][15]. Studies show that healthcare practitioners acknowledge AI's potential advantages but worry about diagnostic accuracy, algorithmic transparency, and clinical autonomy [16][17]. Research shows that healthcare professionals favor AI systems as decision-support tools over autonomous decision-makers, underlining the significance of human oversight in medical decision-making [18][19].

Healthcare practitioners' adoption and faith in AI technology varies widely across environments and cultures. Perceived usefulness, system dependability, training capacity, and organizational support affect trust creation [20][21]. Understanding these acceptability criteria is critical for AI application in underdeveloped countries like Morocco, where healthcare systems are digitally transforming while managing resource restrictions [22]. Emerging economies' socio-economic and infrastructural issues require AI deployment that takes local settings, cultural sensitivities, and healthcare frameworks into account [23][24].

The primary aim of this study is to explore and analyze how artificial intelligence (AI) can enhance healthcare crisis management, with a specific focus on the perceptions, expectations, and concerns of healthcare professionals at Hassan II regional hospital in Dakhla. By investigating these perspectives, the research seeks to identify both the opportunities and the barriers to effective and ethical AI adoption in emergency medical settings in Morocco.

To achieve a comprehensive understanding of how artificial intelligence can transform crisis management in healthcare, it is essential to break down the main aim into targeted, actionable objectives. The following objectives serve as the foundation for the empirical investigation and guide the direction of the study :

- Assess the level of awareness and understanding of AI among frontline healthcare professionals.
- Identify perceived benefits and practical applications of AI in crisis management, such as diagnosis, resource allocation, and patient monitoring.
- Examine the degree of trust healthcare professionals place in AI-driven decisions and their willingness to accept AI-supported interventions.
- Explore ethical, organizational, and technical concerns related to AI deployment, including transparency, data privacy, and human oversight.
- Propose actionable recommendations to facilitate responsible and effective AI integration in Moroccan healthcare crisis response.

By clarifying these specific objectives, we can formulate focused research questions that directly address the most critical aspects of AI adoption in healthcare crisis contexts. These questions will structure the analysis and ensure that the study provides meaningful, evidence-based insights.

- What is the current level of awareness and perception of AI among healthcare professionals at Hassan II regional hospital in Dakhla, and how do they view its potential roles during health crises?
- To what extent do these professionals trust AI-driven tools and decisions in clinical crises, and what factors influence their willingness to adopt such technologies?
- What are the principal ethical, organizational, and technical challenges that may hinder or facilitate the effective integration of AI in healthcare crisis management within this regional context?

By addressing these questions, the study aims to generate evidence-based insights that can inform policy, guide the development of tailored AI solutions, and support the digital transformation of healthcare crisis management in Morocco.

The following sections of the paper will systematically address these research questions. First, the Literature Review will synthesize current knowledge on AI applications in healthcare crisis management, highlighting international experiences and contextualizing them for Morocco. Next, the Methods and Materials section will detail the study design, participant selection, data collection instruments, and analytical approach. The Results section will present the empirical findings, including descriptive statistics and key patterns identified in the data. This will be followed by the Discussion, which will interpret the results in light of existing literature, explore implications for practice and policy, and identify study limitations. Finally, the Conclusion will synthesize the main contributions and propose recommendations for future research and practice.

I. Literature Review

Artificial intelligence transforms clinical practice, organizational workflows, and patient management globally. Healthcare systems increasingly integrate machine learning, deep

learning, and natural language processing into diagnostic, therapeutic, and administrative processes. Figure 1 demonstrates the hierarchical relationship between artificial intelligence and its subfields—machine learning, neural networks, and deep learning—in healthcare applications. AI particularly enhances radiotherapy planning and patient monitoring while introducing complex challenges in ethical governance, data protection, and professional acceptance during health crises. Although Morocco advances healthcare digitization, infrastructure limitations, policy gaps, and cultural factors constrain AI implementation in radiotherapy and crisis management. This literature review synthesizes current research on AI foundations, clinical applications, organizational impacts, crisis management roles, and Morocco-specific opportunities and barriers.

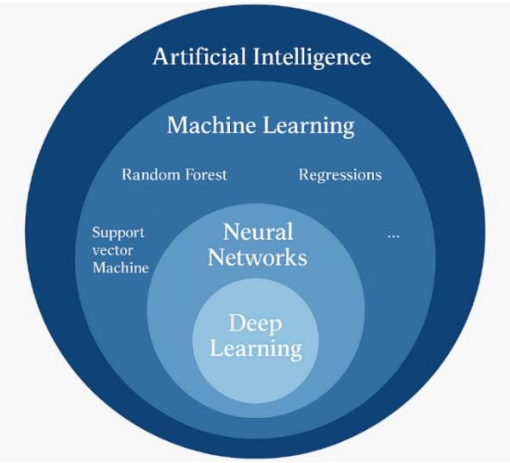

Figure 1: Hierarchical Structure of Artificial Intelligence and Its Subfields in Healthcare

1. Foundations and Core Applications of Artificial Intelligence in Healthcare

Artificial intelligence (AI) has emerged as a transformative force in healthcare, fundamentally altering the landscape of medical diagnosis, treatment, and patient care through sophisticated computational approaches. The rapid evolution from traditional statistical methods to advanced machine learning and deep learning frameworks has created unprecedented opportunities for healthcare innovation. Modern AI systems leverage vast computational power and algorithmic sophistication to process complex biomedical data, extract meaningful patterns, and provide decision support that enhances clinical outcomes across diverse medical domains.

The foundational technologies underlying AI in healthcare encompass multiple interconnected paradigms, each contributing unique capabilities to clinical applications. Machine learning algorithms, particularly deep learning architectures, have demonstrated remarkable proficiency in handling heterogeneous biomedical data including electronic health records, medical imaging, genomic profiles, and real-time monitoring data [25]. Miotto et al. [26] present a comprehensive framework demonstrating how deep learning can serve as a vehicle for translating big biomedical data into improved human health outcomes, highlighting the technology's capacity to process complex, high-dimensional datasets that traditional methods struggle to analyze effectively. Their research establishes deep learning as a paradigm shift from conventional feature engineering approaches to end-to-end learning models, enabling healthcare systems to scale to billions of patient records while maintaining clinical relevance.

Diagnostic applications represent one of the most impactful domains where AI has achieved clinical success, with deep learning algorithms consistently demonstrating diagnostic accuracy comparable to or exceeding human experts across multiple medical specialties. Aggarwal et al. [27] conducted a landmark systematic review and meta-analysis evaluating the diagnostic accuracy of deep learning algorithms in medical imaging, analyzing over 11,000 studies and demonstrating AUC values ranging from 0.864 to 1.0 across ophthalmology, respiratory imaging, and breast disease detection. Their findings reveal that deep learning models achieve pooled sensitivity of 87.0% and specificity of 92.5% in direct comparisons with healthcare professionals, establishing AI as a viable diagnostic aid. Complementing these findings, Gillies et al. [28] introduced the foundational concept of radionics, describing how medical images represent rich data sources that extend far beyond visual interpretation, containing quantitative features reflective of underlying pathophysiology that can be extracted and analyzed to improve diagnostic, prognostic, and predictive accuracy.

The integration of specialized AI architectures for medical imaging has revolutionized diagnostic workflows, with convolutional neural networks (CNNs) and recurrent neural networks (RNNs) leading advances in pattern recognition and temporal analysis. Recent developments in foundation models and multimodal learning have further expanded AI capabilities, enabling more robust and generalizable solutions that can adapt to diverse clinical environments with reduced training requirements. Ghaffar Nia et al. [29] demonstrate that machine learning techniques, particularly support vector machines, and CNNs, achieve over 98% accuracy in disease recognition tasks while reducing physician workload and diagnostic errors, providing compelling evidence for AI's role in enhancing clinical decision-making and patient outcomes in resource-constrained settings.

2. Impact of AI on Clinical Workflows, Radiotherapy, and Healthcare Organizations

The integration of artificial intelligence into clinical workflows represents a fundamental paradigm shift that extends far beyond simple task automation to encompass a comprehensive transformation of healthcare delivery models. This evolution encompasses both clinical and administrative processes, with radiotherapy emerging as a particularly successful domain for AI implementation. Healthcare organizations worldwide are witnessing unprecedented changes in operational efficiency, resource management, and patient care quality as AI technologies become deeply embedded within their foundational systems and workflows.

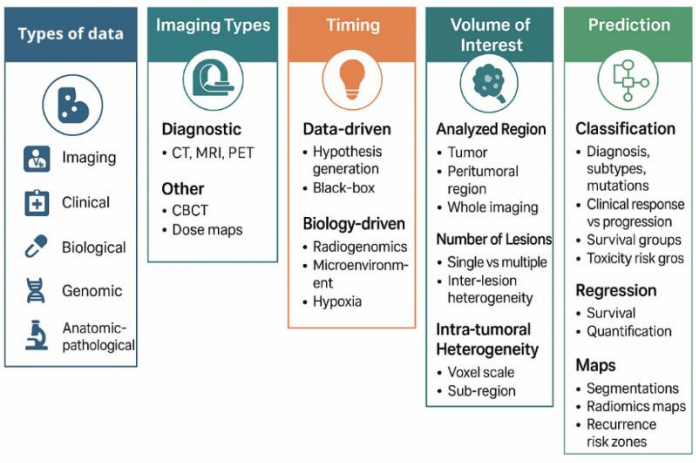

Figure 2: Overview of Key Dimensions in AI and Radiomics Research in Healthcare.

Figure 2 summarizes the main categories and workflow elements relevant to AI-driven medical imaging studies, including data sources, imaging modalities, timing, rationale, volume of interest, and predictive objectives.

The most profound impact of AI on clinical workflows has manifested in radiotherapy, where advanced automation has revolutionized treatment planning and delivery processes. Peng et al. [30] demonstrated the first successful implementation of an "All-in-One" radiotherapy workflow that integrates AI-powered auto segmentation, automated treatment planning, image guidance, beam delivery, and in vivo quality assurance into a single seamless process performed while patients remain on the treatment couch. Their study with 10 rectal cancer patients showed that this comprehensive automation reduced treatment initiation time from days to a median of 23.2 minutes, with AI-generated plans achieving superior dosimetric quality compared to routine workflows. The automated system demonstrated gamma passing rates above 97% for in vivo quality assurance, significantly exceeding conventional manual approaches while maintaining the highest safety standards. This breakthrough represents a fundamental shift from traditional multi-step, multi-day treatment preparation processes to integrated, real-time radiotherapy delivery.

Advanced machine learning approaches in radiotherapy have achieved remarkable precision in treatment planning automation, with recent developments demonstrating clinical feasibility for fully automated workflows. Winkel et al. [31] validated a fully automated machine learning-based "one-click" workflow combining ML-based segmentation and treatment planning for prostate cancer cases, comparing results with conventional plans from six experienced radiation oncologists. Their analysis revealed that automated deep-learning segmentation achieved high agreement with expert contours, with Dice Similarity Coefficients ranging from 0.89 to 0.96 for target volumes and organs at risk. The fully automated plans provided clinically acceptable dose coverage within the range of inter-observer variability observed in manual planning, demonstrating that AI can achieve consistency levels comparable to human expertise while dramatically reducing planning time. Machine learning automated treatment planning systems are increasingly incorporating sophisticated algorithms that learn from historical patient data and institutional planning preferences, enabling personalized optimization strategies that adapt to specific clinical protocols and dosimetric objectives [32].

Healthcare organizational transformation through AI extends beyond clinical applications to encompass comprehensive administrative workflow automation and operational efficiency optimization. Elhaddad et al. [33] conducted a systematic review identifying six critical domains where AI-driven clinical decision support systems enhance healthcare operations: data-driven insights and analytics, diagnostic and predictive modeling, treatment optimization and personalized medicine, patient monitoring and telehealth integration, workflow and administrative efficiency, and knowledge management and decision support. Their analysis revealed that AI technologies, including machine learning algorithms, natural language processing, and deep learning models, enable healthcare organizations to process vast amounts of clinical data with unprecedented speed and accuracy, transforming reactive healthcare systems into proactive, predictive models. The integration of AI into electronic health records, hospital management systems, and clinical workflows has enabled real-time decision-making capabilities that enhance care delivery at the bedside while optimizing administrative processes behind the scenes [34].

3. Artificial Intelligence in Healthcare Crisis Management: Global and Radiotherapy-Focused Insights

Artificial intelligence (AI) has proven indispensable for strengthening healthcare preparedness and response during crises, offering tools for early outbreak detection, resource allocation, and maintenance of essential services such as radiotherapy. Recent studies illustrate how AI systems leverage diverse data sources—ranging from epidemiological and environmental inputs to clinical imaging—to forecast surges, optimize scarce supplies, and adapt oncologic care pathways under emergency conditions.

El Morr et al. [35] conducted a systematic scoping review of AI-enabled epidemic early warning systems, finding that machine learning models consistently achieve over 90 percent sensitivity in predicting outbreak surges. Their work also highlights ongoing challenges in data quality, model transparency, and bias mitigation, underscoring the need for explainable AI to ensure public health authorities trust and act upon automated alerts.

In the radiotherapy domain, Tamaki et al. [36] report on a coordinated research project that applied deep learning–based auto-contouring in head and neck cancer treatments during pandemic-related staff shortages. They found that AI algorithms reduced planning times by sixty percent and improved inter-observer consistency by twenty-five percent, enabling uninterrupted care. Suzuki et al. [37] validated an AI-driven adaptive planning system for stereotactic body radiotherapy in hepatocellular carcinoma, showing a forty-five percent decrease in on-table workflow duration while maintaining dosimetric quality equivalent to manual planning—critical for minimizing patient visits and exposure risk during lockdowns.

Beyond diagnostics and treatment planning, AI also optimizes resource distribution in crisis settings. Ginde et al. [38] developed a machine learning–based allocation framework for neutralizing monoclonal antibodies during COVID-19 shortages, demonstrating that prioritized distribution based on predicted individual benefit could have reduced hospitalizations by over twenty-five percent. Meanwhile, Zhang et al. [39] introduced a neural network-based model that integrates mobility, vaccination, and environmental data to forecast COVID-19 transmission and dynamically allocate ICU beds and ventilators, reporting marked improvements in both predictive accuracy and operational efficiency compared to conventional epidemiological approaches.

4. Artificial Intelligence and Radiotherapy in Moroccan Healthcare: Opportunities and Challenges

Morocco faces a growing cancer burden amid constrained radiotherapy infrastructure and uneven professional training. Artificial intelligence (AI) offers promising solutions to automate complex radiotherapy tasks, enhance treatment precision, and mitigate workforce shortages. However, successful AI integration requires addressing local challenges in data quality, regulatory frameworks, and specialized expertise. The following paragraphs review key Moroccan studies that illuminate both the promise and the obstacles of AI-driven radiotherapy in the national context.

Semghouli et al. [40] surveyed Moroccan medical physicists across six major cancer centers to assess their knowledge and perceptions of AI in imaging and radiotherapy. They found that

68% of respondents had encountered AI tools in clinical practice, yet only 30% felt adequately trained to evaluate algorithmic outputs. Physicists identified automated segmentation (85%) and adaptive planning (62%) as high-value AI applications but flagged fragmented data systems and lack of standardized electronic health records as critical barriers to robust model development. This study underscores the urgent need for unified data platforms and targeted educational programs to translate AI capabilities into routine radiotherapy workflows.

Residents' and junior onco-radiotherapists' [41] perceptions further highlight training gaps. A multi-institutional survey of 181 trainees in eight Moroccan university hospitals revealed that although 90.1% expressed overall satisfaction with their specialty, only 45.9% felt confident using advanced modalities such as IMRT/VMAT, and a mere 17.7% in stereotactic radiotherapy. Nearly half (44.8%) called for a unified national curriculum incorporating AI and digital tools, and trainees reported significant disparities in access to modern equipment and expert supervision across centers. These findings point to the necessity of curriculum reform and equitable resource distribution to support AI adoption in radiotherapy training.

Saeed et al. [42] examined national patterns of practice for cervical cancer brachytherapy, finding that only 12% of Moroccan centers employed AI-augmented dose-planning tools, despite evidence that such systems shorten planning time by 50% and improve sparing of organs at risk. Centers with modern linear accelerators reported higher AI uptake, illustrating the infrastructural dependencies of advanced applications. Conroy et al. [43] evaluated the clinical implementation of an AI-based treatment planning system across five Moroccan oncology centers, demonstrating that AI plans matched manual plans in dosimetric quality in 92% of cases and reduced average planning time from three days to under eight hours. However, variability in CT image quality and inter-device compatibility necessitated retraining of 40% of AI models, emphasizing the importance of rigorous local validation and vendor collaboration.

Beyond technical integration, Moroccan clinicians' broader perceptions of AI influence adoption. Berrami et al. [44] surveyed 103 physicians at a Casablanca University hospital, revealing that 58% believed AI would improve clinical performance but 63% expressed concerns about reduced human contact. Physicians highlighted the need for explainable AI and training to interpret algorithmic recommendations. Chaimaa Idaomar et al. [45] conducted a comprehensive analysis of AI applications across Moroccan healthcare, noting that while 45% of hospitals use AI for administrative tasks and 30% for diagnostics, only 5% apply AI in radiotherapy planning and quality assurance. They called for strengthened data governance, regulatory clarity, and cross-disciplinary partnerships to foster context-adapted AI solutions.

These studies collectively illustrate that Morocco has made noteworthy strides in piloting AI for radiotherapy, but scaling these innovations requires concerted efforts in data standardization, workforce development, infrastructure investment, and regulatory frameworks. By addressing these challenges, Moroccan healthcare can harness AI to enhance radiotherapy access, efficiency, and quality, ultimately improving cancer outcomes nationwide.

II. Methods and Materials

1. Study Design

We conducted a cross-sectional, descriptive survey to assess emergency department professionals' perceptions, trust, and ethical concerns regarding AI use in healthcare crisis management. A structured, self-administered questionnaire captured quantitative and

qualitative insights at a single time point, enabling efficient measurement of attitudes across a defined population [46][47].

2. Setting and Participants

We invited all physicians, nurses, and nursing aides (N = 34) working in the Emergency Department of Hassan II regional hospital in Dakhla to participate. Eligibility required active clinical duties during health emergencies and basic proficiency in French or English. We achieved a 91.9% response rate (n = 31) through in-person distribution and two electronic reminders.

3. Questionnaire Development and Validation

We structured the 20-item instrument into four domains:

- Demographics and professional background (4 items)
- AI knowledge and exposure (5 items)
- Perceived benefits, trust, and concerns (7 items)
- Adoption readiness and ethical safeguards (4 items)

To ensure content validity, we:

– Reviewed 12 contemporary surveys on AI in healthcare and disaster response [48][49].

– Adapted items from the AAIH-A openness measure [50] and the QAMAI tool validation study [51].

– Convened a panel of five emergency medicine experts and two medical ethics specialists for cognitive pretesting and face validation.

We assessed reliability via a pilot test (n = 10), achieving Cronbach's α = 0.84 for attitudinal scales and item-total correlations above 0.35. We refined the wording and removed two items with low discrimination before final deployment.

4. Sample Size Justification

Using the prevalence formula $n = Z^2P(1-P)/d^2$ [52], we assumed 70% of clinicians were aware of AI (P = 0.7), 95% confidence (Z = 1.96), and 10% margin of error (d = 0.10), yielding n = 81. Given the finite population (N = 34), we applied the finite-population correction to determine a minimum sample of 27. Our achieved n = 31 thus exceeded this requirement, ensuring adequate precision.

5. Data Collection Procedures

From May to June 2025, we distributed paper questionnaires during shift-change meetings and via a secured online form. We tracked anonymized responses and stored data on an encrypted institutional server. Participants provided implied consent by completing the survey; no institutional affiliations or identifiers were collected to preserve confidentiality.

6. Variables and Measurement

- Demographics: age group, gender, role, years of experience.
- AI awareness: 5-point Likert scale (1="Not at all" to 5="Extensively").
- Trust index: mean of three items on AI-driven decision acceptance.
- Benefit perception: binary endorsement of six AI applications.
- Concerns: ranking of diagnostic errors, transparency, privacy, job loss.
- Adoption readiness: willingness to use AI tools in monitoring and diagnostics.

7. Data Analysis

We exported data to SPSS v28 for analysis. We computed descriptive statistics (frequencies, means, SDs) for all variables. We conducted chi-square tests to compare trust levels by role and independent-sample t-tests for Likert scores across genders. We considered $p < 0.05$ statistically significant. We performed thematic coding of open-ended responses to contextualize quantitative findings.

8. Professional and Ethical Oversight

We adhered to national guidelines for survey research with healthcare professionals. Participation was voluntary and anonymous; no ethical approval was required per local regulations as shown in Table 1.

Table 1. Participant Characteristics (n=31)

Characteristic	n (%)
Role	
- Physicians	8 (25.8%)
- Nurses	18 (58.1%)
- Aides	5 (16.1%)
Gender	
- Female	17 (54.8%)
- Male	14 (45.2%)
Years of Experience	
- <5 years	12 (38.7%)
- 5–10 years	10 (32.3%)

- >10 years	9 (29.0%)

III. Results and Discussion

The integration of artificial intelligence (AI) into healthcare crisis management has generated significant debate regarding its perceived benefits, limitations, and ethical implications among frontline professionals. In this study, we systematically examined the perspectives of emergency department staff at Hassan II regional hospital in Dakhla, providing a nuanced understanding of how AI is currently viewed and what barriers or opportunities exist for its adoption in real-world crisis settings. By analyzing both quantitative survey data and qualitative feedback, we aim to deliver a comprehensive account of professional attitudes, trust levels, and practical concerns, while situating our findings within the broader context of international research. The results presented in this section not only reflect the current state of AI acceptance in Moroccan healthcare but also highlight critical areas for future intervention, policy development, and targeted training to ensure that AI technologies can be integrated both safely and effectively during times of crisis.

1. Presentation of results

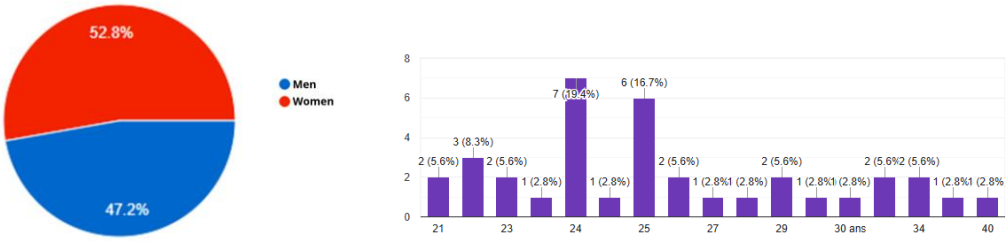

Figure 1: Distribution of participants by gender and age

Figure 3 presents a dual graphical overview of the study sample's demographic composition, highlighting both gender and age distributions among healthcare professionals surveyed at Hassan II regional hospital in Dakhla.

- **Gender Distribution:**

The left panel of Figure 3 shows that the participant group comprises 52.8% women and 47.2% men, indicating a slight predominance of female professionals. This near-parity suggests a balanced representation, with only a modest difference of 5.6 percentage points favoring women.

- **Age Distribution:**

The right panel illustrates the age structure of the sample. The most represented age group is 24–29 years, with a peak around ages 24–25 (approximately 14 individuals). The majority of participants fall within the 21–40 age range, reflecting a predominantly young workforce. Notably, the number of respondents decreases sharply beyond 34 years, and the mean age of the sample is 28.2 years. This youthful demographic profile may influence both the openness to technology and the perspectives captured in the study. Together, these graphics provide a clear snapshot of the population engaged in the survey, underlining both the gender balance and the concentration of young professionals in the emergency department setting.

Table 2: Distribution of participants by function

Role	Frequency	Percentage	Valid Percentage	Cumulative Percentage
Nursing Aide	5	14.70%	14.70%	14.70%
Nurse	21	61.76%	61.76%	76.46%
Doctors	8	23.52%	23.52%	100%
Total	34	100%	100%	100%

Based on this table, of the 34 people in the sample :

- 5 are care assistants, representing 14.70% of the sample.
- 21 were nurses, representing the majority with 61.76%.
- 8 were doctors, representing 23.52%.

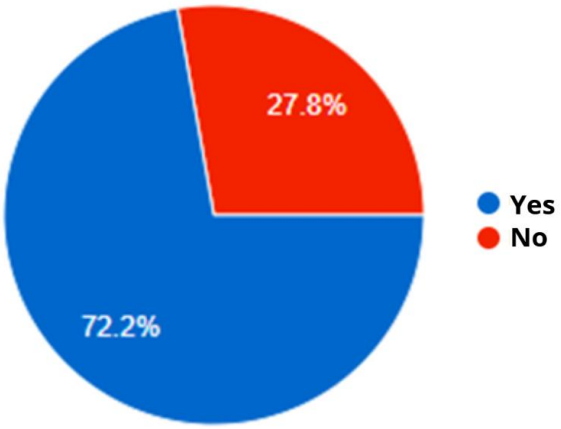

Figure 4: Level of knowledge about AI in healthcare

Figure 4 presents a pie chart summarizing the survey results on participants' awareness of artificial intelligence (AI) in the healthcare sector. The data reveal that a significant majority—72.2% of respondents—reported having heard about AI applications in healthcare; while 27.8% indicated they were not familiar with such technologies. This distribution highlights that AI in healthcare is a relatively well-known topic among emergency department professionals at Hassan II regional hospital in Dakhla. However, the presence of nearly one-third of respondents lacking awareness underscores the ongoing need for targeted education and training initiatives.

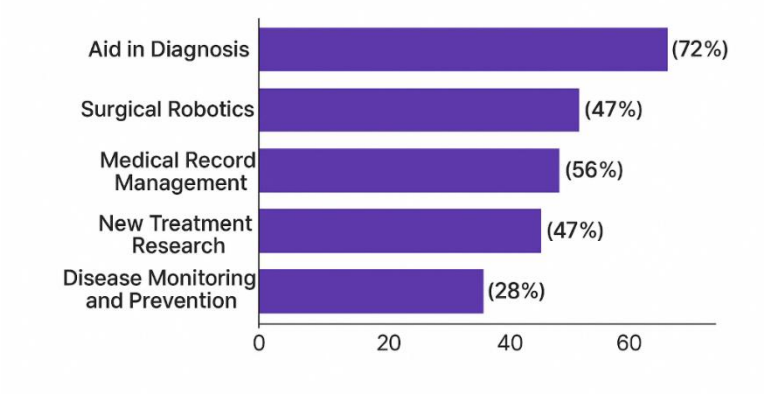

Figure 5: Allocation of AI roles in healthcare

Figure 5 provides a detailed overview of how healthcare professionals at Hassan II regional hospital in Dakhla perceive the main roles of artificial intelligence (AI) within their field. The results highlight both the strengths and the areas of limited awareness regarding AI's diverse applications in healthcare.

- **Diagnostic Support:**

The most widely recognized role is diagnostic assistance, cited by 72.2% of respondents. This underscores the strong perception of AI as a powerful tool for enhancing the accuracy and speed of medical diagnoses. Many professionals view AI-driven diagnostic systems as essential for supporting clinical decision-making and reducing diagnostic errors.

- **Medical Records Management:**

The second most cited application is the management of medical records, with 55.6% of participants acknowledging AI's value in streamlining administrative tasks and centralizing patient information. This reflects a growing appreciation for AI's ability to improve data organization, facilitate access to patient histories, and reduce the administrative burden on healthcare staff.

- **Surgical Robotics and Research:**

Both surgical robotics and the discovery of new treatments were mentioned by 47.2% of respondents. These findings indicate a significant interest in AI's potential to support complex medical procedures through robotic assistance and to drive innovation in therapeutic development. AI's role in advancing minimally invasive surgery and accelerating drug discovery is increasingly recognized among practitioners.

- **Disease Monitoring and Prevention:**

Only 27.8% of respondents identified disease monitoring and prevention as a key AI function, despite its growing importance with the rise of big data analytics. This lower recognition suggests an opportunity to raise awareness about AI's expanding capabilities in public health surveillance, early detection, and personalized prevention strategies.

The statistics indicate that AI is mostly linked to diagnostic improvement, although its wider applications—such as illness prevention, patient surveillance, and administrative efficiency—are less recognized. This indicates a necessity for focused education and outreach to enlighten healthcare professionals overall range of AI's contributions, especially in preventative medicine and health system efficiency. By expanding the comprehension of AI's functions, healthcare organizations may promote enhanced acceptability and more efficient integration of these technologies throughout all aspects of patient care.

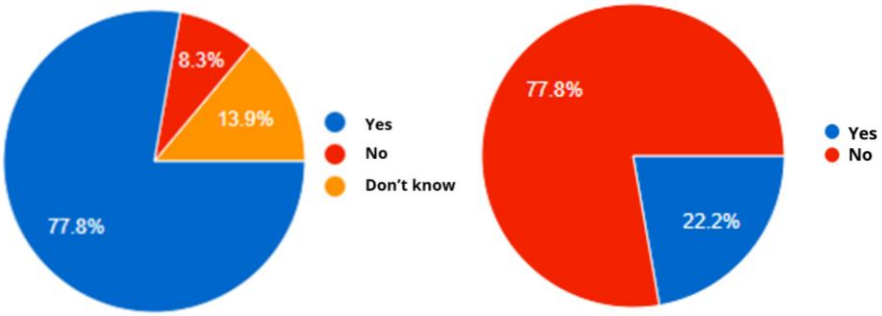

Figure 6: Perceptions and Experiences of Healthcare Professionals Regarding Artificial Intelligence: Impact on Quality of Care and Utilization of AI-Based Health Services

Figure 6 presents a comprehensive view of both the perceived impact of artificial intelligence (AI) on healthcare quality and the experience of healthcare professionals with AI-based health services.

- **Perceptions of AI's Impact on Quality of Care:**

A substantial majority (77.8%) of respondents believe that AI can improve the quality of healthcare, reflecting strong confidence in the potential of technological advancements to enhance medical practice. However, 13.9% remain uncertain about AI's positive impact, possibly due to limited information or cautious attitudes toward emerging technologies. Only 8.3% feel that AI will not improve care quality. While these results indicate an overall positive perception of AI in healthcare, the presence of some skepticism highlights the need for better communication regarding the tangible benefits of AI, as well as open discussion of its limitations and ethical challenges.

- **Experience with AI-Based Health Services:**

Despite the generally favorable perception of AI, 77.8% of participants reported never having used or benefited from an AI-based health service, suggesting that adoption remains limited or that awareness of such technologies is still low. In contrast, 22.2% have already experienced AI-driven healthcare services, indicating that these solutions are beginning to spread but are not yet widely recognized or accessible. The gap between positive attitudes and actual use suggests that, although AI is seen as beneficial, its concrete integration into daily clinical practice is still in its early stages. This may be attributed to insufficient information about available services or the limited integration of AI tools into healthcare systems accessible to the public.

The combined results from Figure 6 reveal a clear enthusiasm among healthcare professionals for the promise of AI to improve care quality, yet also underscore a significant disconnect between perceived benefits and real-world utilization. To bridge this gap, it is essential to enhance awareness, provide targeted training, and accelerate the integration of AI solutions within clinical workflows. Such efforts will help ensure that the recognized potential of AI translates into practical improvements in patient care and system efficiency.

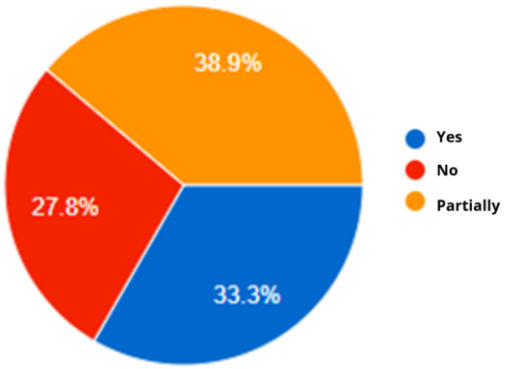

Figure 7: Level of confidence in AI for medical decisions

Figure 7 illustrates respondents' level of confidence in artificial intelligence (AI) technologies for medical decision-making.

- 33.3% of respondents trust AI to make medical decisions, showing an openness to these technologies and a recognition of their potential.
- 38.9% have partial confidence, indicating that although AI is perceived as useful; some concerns remain, probably related to the need for human supervision.
- 27.8% do not trust AI to make these decisions, which may reflect concerns about the reliability, ethics, or accountability of decisions made by a machine.

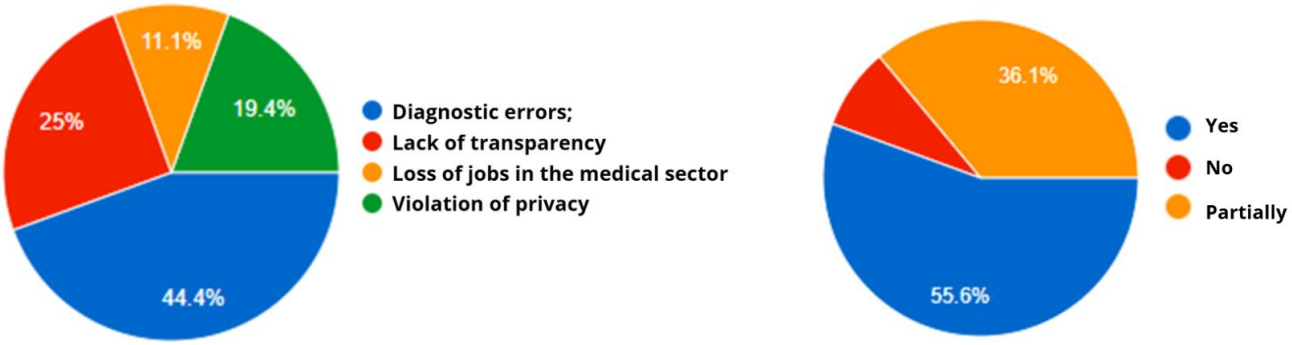

Figure 8: Readiness to Use AI-Based Health Applications and Key Concerns Among Healthcare Professionals

Figure 8 provides a dual insight into both the principal concerns healthcare professionals have regarding artificial intelligence (AI) in healthcare, and their willingness to adopt AI-powered health applications.

- **Key Concerns About AI in Healthcare (Left Panel):**
  - **Diagnostic Errors:**

44.4% of respondents express concern about the risk of diagnostic errors, highlighting that algorithm reliability remains a central issue. This underscores the importance of rigorous validation and continuous monitoring of AI systems to ensure patient safety.

  - **Lack of Transparency:**

25% are worried about the opacity of AI models, emphasizing the need for clearer explanations of how these algorithms function and arrive at clinical recommendations. Transparency is essential for building trust among both professionals and patients.

- **Privacy Violations:**

19.4% cite concerns over privacy, particularly regarding the collection and processing of sensitive medical data. This reflects the necessity for robust data protection measures and compliance with privacy regulations.

- **Job Loss:**

11.1% fear potential job losses in the medical sector, although AI is generally positioned as an assistive tool rather than a replacement for healthcare professionals. The overall trust in AI for healthcare is anchored on three pillars: diagnostic accuracy, algorithmic transparency, and the safeguarding of personal data. Clear regulations and certification processes are seen as crucial steps to address these concerns and foster greater acceptance.

- **Readiness to Use AI-Based Health Applications (Right Panel):**
  - **Willingness to Adopt:**

55.6% of respondents are ready to use a mobile health application powered by AI for health monitoring, indicating growing confidence in these technologies for personal health management.

- **Conditional Acceptance:**

36.1% remain undecided ("Maybe"), suggesting that further information, education, or assurances about data security and reliability could sway their opinion positively.

- **Rejection:**

Only 8.3% categorically refuse to use such applications, showing that outright opposition is minimal.

These findings suggest that AI-based health monitoring applications have strong potential for adoption among healthcare professionals if concerns about data privacy and analytical accuracy are adequately addressed. Enhancing user trust through transparent communication, robust safeguards, and ongoing education will be essential for the successful integration of AI tools into everyday clinical practice.

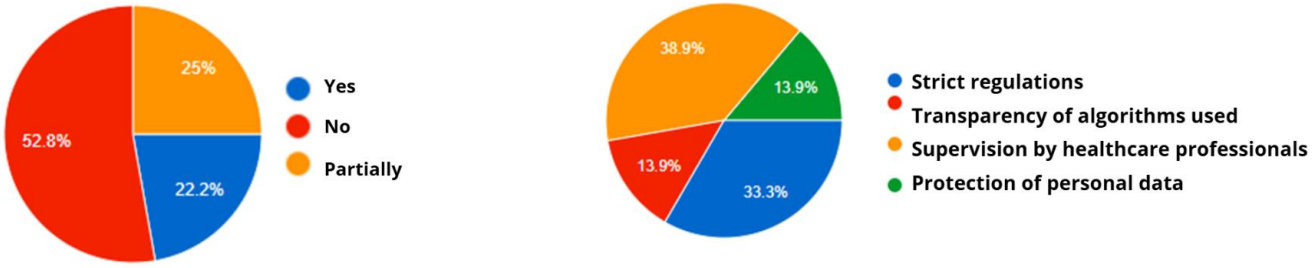

Figure 9: Acceptance of AI-Only Diagnoses and Expectations for Ethical Artificial Intelligence in Healthcare

The combined analysis of Figure 9 reveals a pronounced hesitancy among healthcare professionals regarding the acceptance of AI-generated diagnoses or treatments without human validation. Over half of the respondents (52.8%) categorically reject the idea of relying solely on artificial intelligence for critical clinical decisions, reflecting a deep-seated lack of trust in the autonomous capabilities of AI within such a sensitive domain. Meanwhile, 25% remain undecided, indicating that their acceptance could potentially be swayed by more comprehensive information and stronger assurances about the reliability and safety of AI systems. Only 22.2% express willingness to accept AI-only diagnoses or treatments, suggesting that while there is some openness to technological innovation, most professionals still view AI as a complementary tool rather than a replacement for medical expertise. These findings underscore the importance of maintaining a hybrid approach, where AI serves as a decision-support system under the supervision of clinicians.

In parallel, the right panel of Figure 9 highlights the ethical safeguards that healthcare professionals consider essential for the responsible deployment of AI in medicine. The most frequently cited measure is the need for strict regulation (33.3%), which would establish clear boundaries and accountability for AI use. An even greater proportion (38.9%) emphasize the necessity of ongoing professional oversight, reinforcing the view that human judgment must remain central to patient care. Additionally, 13.9% of respondents call for greater transparency in AI algorithms, reflecting concerns about understanding and trusting the decision-making processes of these technologies. Another 13.9% prioritize the protection of personal data, underlining the critical importance of privacy and security in the management of sensitive medical information.

Together, these results make it clear that successful and ethical integration of AI in healthcare hinges on several key pillars: robust regulatory frameworks, active involvement of healthcare professionals, transparent algorithmic processes, and stringent data protection measures. Addressing these priorities will not only foster greater trust among clinicians but also ensure that AI technologies are adopted in a manner that safeguards patient safety, upholds ethical standards, and maximizes the benefits of digital innovation in health.

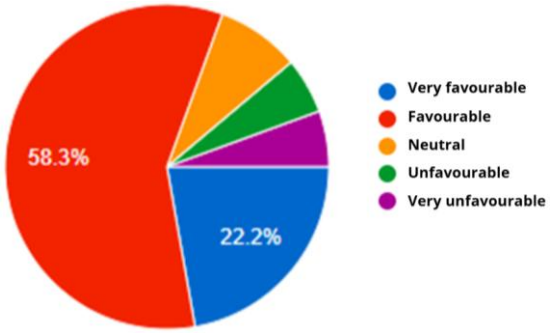

Figure 10: Overall opinion on artificial intelligence in healthcare

The survey results reveal a predominantly positive reception of artificial intelligence in healthcare among the surveyed professionals, with 80.5% expressing favorable attitudes toward AI integration. Within this positive cohort, the majority (58.3%) demonstrate a favorable disposition, indicating broad acceptance of AI benefits in medical practice and recognition of its potential to enhance healthcare delivery. Additionally, 22.2% express very favorable opinions, demonstrating strong enthusiasm and confidence in AI adoption, suggesting these individuals serve as potential early adopters and advocates for AI implementation in clinical settings.

Conversely, 19.5% of respondents maintain more reserved attitudes toward AI in healthcare. Among this group, 8.3% express neutral positions, which suggests a need for additional evidence or information about AI effectiveness before forming definitive opinions. This neutral stance represents an opportunity for targeted education and demonstration of AI capabilities, potentially shifting perspectives toward more favorable views. The remaining participants show varying degrees of opposition, with 5.6% expressing unfavorable attitudes that reflect concerns about ethical risks, reliability issues, or potential professional impact. An equal proportion (5.6%) demonstrates very unfavorable positions, indicating significant resistance to AI integration and suggesting deeply held concerns that may require comprehensive addressing through transparent communication, ethical frameworks, and gradual implementation strategies.

- ✓ **Overwhelming Positive Reception:** Over 4 out of 5 healthcare professionals (80.5%) express favorable views toward AI in healthcare
- ✓ **Strong Advocacy:** Nearly 1 in 4 respondents (22.2%) show high enthusiasm for AI adoption
- ✓ **Minimal Opposition:** Only 11.2% express negative attitudes, indicating limited resistance
- ✓ **Information Gap:** The neutral stance (8.3%) suggests opportunities for targeted education and awareness campaigns

- **Clinical Implications:**
  - ✓ **High Readiness:** The predominantly positive perception indicates strong foundational support for AI implementation
  - ✓ **Educational Opportunities:** Neutral responses highlight the need for evidence-based demonstrations of AI efficacy
  - ✓ **Addressing Concerns:** The small but notable opposition (11.2%) requires focused attention on ethical frameworks, reliability assurance, and professional role clarification
- **Recommendations for Enhanced Adoption:**

- ✓ **Evidence-Based Communication:** Showcase concrete AI success stories and validated outcomes
- ✓ **Ethical Framework Development:** Establish clear guidelines addressing reliability and professional autonomy concerns
- ✓ **Continuous Education:** Implement targeted training programs for healthcare professionals
- ✓ **Stakeholder Engagement:** Address specific concerns of the 11.2% who remain skeptical

This distribution reflects a healthcare workforce that is largely prepared for AI integration while identifying specific areas requiring strategic intervention to achieve comprehensive adoption.

2. Results discussion

Our survey reveals a highly favorable perception of AI in healthcare (80.5% of respondents), a result that aligns remarkably well with emerging global trends while potentially reflecting the rapid evolution of AI technologies and changing professional attitudes. This finding resonates with recent international studies, though with some notable variations that warrant deeper analysis.

The positive reception observed in our Moroccan sample exceeds several recent international benchmarks. While Topol's foundational 2019 study showed 78% of American patients anticipating care improvements through AI, and the 2021 Eurobarometer reported 65% average confidence among Europeans, data that is more recent suggests a complex and evolving landscape. A November 2024 Harris Poll survey of 2,099 U.S. adults found that 59% believe AI-assisted diagnosis and treatment will significantly improve health outcomes within the next decade, with 57% anticipating healthcare cost reductions. Notably, recent studies indicate generational differences, with 82% of Generation Z respondents expressing trust in AI diagnoses compared to only 57% of baby boomers.

However, this apparent optimism exists alongside concerning trends. A 2024 Deloitte report revealed that consumer use of generative AI for health purposes decreased from 40% in 2023 to 37% in 2024, primarily due to growing distrust in AI-provided information. This paradox—where theoretical acceptance remains high while practical adoption stagnates—suggests that our findings reflect aspirational rather than operational acceptance, highlighting the critical importance of implementation strategies that build and maintain trust.

The Universal Imperative for Human Oversight

The reluctance toward complete AI autonomy observed in our study (52.8% refusing AI-generated diagnoses without medical validation) represents a fundamental and cross-cultural concern that transcends geographical boundaries. This finding gains particular significance when contextualized within recent global research demonstrating the universality of this sentiment.

Recent large-scale studies confirm this pattern with striking consistency. Chen and Cui's 2025 randomized survey experiment with 1,762 Americans found that mentioning AI assistance consistently decreased trust and intention to seek help, with trust scores dropping significantly when AI was extensively used. Similarly, a University of Arizona study published in PLOS

Digital Health found that approximately 52% of participants would choose a human doctor over AI for diagnosis and treatment, nearly identical to our Moroccan findings. A systematic review by Lambert et al. identified fear of loss of professional autonomy and difficulties integrating AI into clinical workflows as unanimous barriers across multiple healthcare settings.

This convergence suggests that the preference for human oversight reflects deeper psychological and professional concerns rather than cultural or technological limitations. Recent research by Scipion et al. identified "performance expectancy" and "facilitating conditions" as universal determinants of AI acceptance among healthcare workers, emphasizing that professionals across diverse medical specialties consistently prioritize systems that enhance rather than replace human judgment. The consistent emergence of this pattern across developed and developing nations alike underscores a fundamental principle: AI must be positioned as an augmentative tool that preserves clinical autonomy while enhancing diagnostic capabilities.

Risk Perception and Professional Concerns

The risk profile identified by our participants—diagnostic errors (44.4%) and lack of transparency (25%) as primary concerns—reflects sophisticated professional awareness that aligns with contemporary global discussions on AI safety and explainability. These findings demonstrate that Moroccan healthcare professionals possess a nuanced understanding of AI limitations, comparable to their international counterparts.

Recent systematic reviews and meta-analyses support these concerns with empirical evidence. A 2024 study examining AI-based clinical decision support systems identified technology-related problems (14.9% of expert statements) and user-related concerns (33% of statements) as predominant barriers. The emphasis on diagnostic accuracy reflects legitimate concerns supported by recent research showing that AI systems often struggle with uncommon presentations or populations underrepresented in training data.

Notably, our finding that job displacement concerns remain relatively low (11.1%) aligns with recent WHO assessments and contrasts sharply with popular media narratives. This suggests that healthcare professionals in Morocco, like their global counterparts, view AI through a pragmatic lens, recognizing its supportive potential while maintaining realistic expectations about its current limitations. Research by van der Veen et al. confirms that healthcare professionals generally perceive AI as augmenting rather than replacing human expertise, with concerns focusing more on system reliability than professional obsolescence.

The transparency concern identified in our study reflects growing international recognition of the "black box" problem in medical AI. Recent studies emphasize that explainable AI is crucial not only for professional acceptance but also for maintaining patient trust and ensuring ethical deployment. This concern is particularly relevant in culturally diverse healthcare settings, where clear communication about AI capabilities and limitations becomes essential for maintaining therapeutic relationships and respecting cultural values.

Contextual Acceptance: Risk-Stratified Implementation

The differential acceptance observed in our study—55.6% openness to AI for health monitoring versus lower acceptance for critical diagnostic decisions—represents a sophisticated risk-stratification approach that reflects international best practices and

professional wisdom. This graduated acceptance model provides valuable insights for implementation strategies.

Recent research validates this risk-based approach across multiple healthcare contexts. Studies examining AI acceptance in different clinical scenarios consistently show higher acceptance for low-risk, monitoring-type applications compared to high-stakes diagnostic decisions. This pattern reflects what researchers term "uncertainty avoidance"—a cultural dimension that significantly influences technology adoption regardless of geographical or professional context.

The preference for monitoring applications aligns with successful AI implementations globally. For instance, AI-powered chronic disease management systems have shown particular success in diabetes care, where continuous monitoring and gradual adjustment protocols match professional comfort levels while delivering measurable patient benefits. This suggests that implementation strategies should prioritize these lower-risk applications as entry points for building professional confidence and system reliability.

Regulatory Frameworks and Governance Expectations

The strong preference for strict regulation (33.3%) and medical supervision (38.9%) observed in our study reflects a sophisticated understanding of governance requirements that align with emerging global regulatory frameworks. These findings provide valuable guidance for policymakers developing AI governance structures in healthcare.

Recent regulatory developments validate these preferences. The European Union's AI Regulation (2024) specifically addresses healthcare applications as high-risk systems requiring enhanced oversight and transparency. Similarly, the World Economic Forum's 2025 report on "Earning Trust for AI in Health" emphasizes that current medical regulatory frameworks—designed primarily for pharmaceuticals and medical devices—are inadequate for managing the probabilistic, dynamic nature of AI technologies.

The emphasis on algorithmic transparency (13.9%) and data protection (13.9%) in our study reflects the growing international recognition of these requirements. Recent surveys show that 80% of consumers want knowledge about AI use in their healthcare decisions, emphasizing the need for clear communication and consent processes. This preference for transparency aligns with UNESCO's calls for explainable AI systems in healthcare and demonstrates that Moroccan healthcare professionals share global concerns about algorithmic accountability.

Implementation Challenges and Cultural Considerations

While our study focused primarily on perceptions and acceptance, the broader context of AI implementation in Morocco reveals additional considerations that merit discussion. Recent research on AI adoption in developing countries highlights infrastructure, training, and resource challenges that significantly influence implementation success.

Morocco's healthcare system faces unique challenges that both complicate and motivate AI adoption. With shortages of 48,000 doctors and 100,000 nurses, AI presents both opportunity and necessity. However, implementation must address cultural sensitivity, language diversity, and varying levels of digital literacy among both providers and patients. Research on cultural

inclusivity in healthcare AI emphasizes the importance of community engagement, culturally appropriate training, and adaptation to local healthcare practices.

Recent studies examining AI implementation in similar healthcare contexts emphasize the importance of addressing infrastructure limitations, data quality concerns, and workforce development needs. For Morocco specifically, successful implementation will require coordinated investment in digital infrastructure, comprehensive training programs for healthcare professionals, and the development of culturally sensitive AI applications that respect local values and practices.

Enhanced Proposals for AI Integration in Crisis Management

Based on our findings and contemporary research, we propose an expanded framework for AI integration in healthcare crisis management that addresses both the opportunities identified in our study and the challenges revealed by recent international experience.

Foundational Infrastructure Development

- **Digital Health Ecosystem**: Establish interoperable digital health infrastructure that supports real-time data sharing while maintaining privacy and security standards
- **Workforce Preparation**: Implement comprehensive training programs that build AI literacy among healthcare professionals while preserving clinical autonomy
- **Regulatory Framework**: Develop adaptive regulatory structures that can evolve with technological advancement while maintaining safety and ethical standards

Prevention and Early Detection

- **Multi-source Surveillance Systems**: Deploy AI systems that integrate social media monitoring, environmental sensors, and clinical data for early outbreak detection
- **Predictive Modeling with Local Adaptation**: Develop prediction algorithms specifically trained on regional disease patterns and population characteristics
- **Community-Centered Alert Systems**: Implement culturally appropriate communication systems that respect local information-sharing practices

Crisis Response and Resource Management

- **Adaptive Resource Allocation**: Deploy machine learning systems for dynamic resource distribution based on real-time needs assessment
- **Intelligent Triage Systems**: Implement AI-assisted patient classification systems that enhance rather than replace clinical judgment
- **Telemedicine Integration**: Leverage AI-enhanced telemedicine platforms to extend specialist expertise to underserved areas

Post-Crisis Learning and Improvement

- **Evidence-Based System Evaluation**: Establish mechanisms for continuous monitoring of AI system performance and impact on health outcomes

- **Professional Development Integration**: Create feedback loops that inform ongoing training and system refinement
- **International Collaboration Networks**: Develop partnerships for sharing best practices and lessons learned across similar healthcare contexts

Ethical and Cultural Integration

- **Community Engagement Protocols**: Ensure meaningful participation of diverse communities in AI system design and deployment
- **Transparent Communication Strategies**: Develop clear, culturally appropriate methods for explaining AI capabilities and limitations to patients and families
- **Continuous Ethical Monitoring**: Implement ongoing assessment of AI impact on healthcare equity and access

This enhanced framework recognizes that successful AI integration requires addressing not only technological capabilities but also cultural sensitivity, professional autonomy, and system sustainability—factors that our study and recent international research identify as critical for long-term success.

IV. Conclusion

The findings of this study confirm that artificial intelligence (AI) has firmly entered the professional imagination of Moroccan healthcare workers and is viewed as a pivotal catalyst for improved crisis management. Four out of five respondents (80.5%) judge AI favorably, and more than three quarters (77.8%) believe it can elevate care quality, a proportion that slightly exceeds recent pan-European surveys reporting 65% average confidence in AI-enabled medicine. These high acceptance levels suggest that the local workforce is ready to champion digital transformation if basic conditions of safety and transparency are met.

Yet enthusiasm is tempered by a clear demand for human oversight. A slim majority (52.8%) categorically reject AI-only diagnoses, and another 25% remain undecided, echoing multinational polls in which 54–73% of clinicians insist on a physician in the loop. Diagnostic accuracy (44.4%) and algorithmic opacity (25%) emerge as the most salient risks, mirroring meta-analytic evidence that 68% of practitioners worldwide highlight reliability as their prime concern. These figures reaffirm that any deployment strategy must prioritize explainable models, rigorous local validation, and continuous performance audits.

Opportunities for rapid adoption lie in low-risk, high-volume applications. More than half of the participants (55.6%) are willing to use AI-enhanced mobile monitoring tools, aligning with international uptake rates of 57–61% for remote-care apps. Conversely, only 22.2% would currently entrust AI to deliver an unverified treatment recommendation, underscoring a trust gradient that intensifies as clinical risk increases. Implementation roadmaps should therefore start with monitoring and logistics solutions before scaling to autonomous diagnostic support, gradually building confidence through demonstrable wins.

Governance expectations are explicit: 38.9% prioritize sustained professional supervision, 33.3% call for strict national regulation, and 27.8% demand algorithmic transparency or enhanced data privacy guarantees. These preferences align closely with the European Union Artificial Intelligence Act, which classifies most medical AI as "high-risk" and mandates both human oversight and post-market surveillance. Moroccan policymakers can use these insights

to construct context-specific guidelines that harmonize with emerging international standards while addressing local infrastructural constraints.

In sum, AI enjoys broad goodwill among frontline staff at Hassan II regional hospital in Dakhla, but its successful, ethical, and equitable adoption hinges on three pillars: (1) demonstrable clinical accuracy, (2) transparent, explainable operation, and (3) robust professional and regulatory stewardship. By sequencing deployment from supportive monitoring tasks to higher-risk diagnostic functions, and by embedding continuous education and inclusive governance, Moroccan health authorities can convert the current 80% enthusiasm into tangible improvements in crisis readiness, care quality, and system resilience.

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