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Narrative Review on the Role of Artificial Intelligence in Solving the Problems of Orthopaedic Care in Low and Middle-Income Countries

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Abstract

Background: The application of Artificial Intelligence (AI) in orthopaedics is rapidly evolving. There are unique challenges in managing musculoskeletal conditions in Low and Middle-Income Countries (LMIC) that could be addressed with artificial intelligence. However, there is limited information on how AI can be integrated to solve these problems. The review aims to identify ways AI integration can address the challenges associated with the care of orthopaedic patients in these resource-poor regions.

Scope: A literature search was conducted in Medline, PubMed, and Google Scholar, and articles were reviewed to evaluate the role of artificial intelligence in solving the problems of orthopaedic care in LMIC.

Findings: It was observed that some of the challenges to musculoskeletal care inherent in these regions include a lack of access to implants and equipment for fracture fixation, limited availability of trained manpower, overwhelming prevalence of musculoskeletal conditions, suboptimal patient follow-up, and deficiencies in medical record-keeping. AI integration can resolve these problems in many ways; inventory analytics and simulation models can control supply chain responsiveness and predict implant shortages, AI assistants can help in making diagnoses or recommend treatment/rehabilitation services, and automate documentation using Natural Language Processing (NLP) to reduce workload. Others are integrating AI into remote consultation to improve follow-up care and automating clinical notes and data entry to improve record-keeping.

Conclusion: The integration of AI in the care of orthopaedic patients is evolving. Its importance in addressing some problems exclusive to the practice of orthopaedics in LMIC cannot be overemphasized. Conducting more research within this field will accelerate this advancement.

Keywords: Artificial Intelligence; Orthopaedics; Low and Middle-Income

Introduction

Artificial intelligence (AI) refers to the development of systems that enable machines to perform tasks that would naturally require human intelligence [1]. It is a branch of computer science that trains systems to mimic human intelligence [2]. It is unique in its ability to learn, adapt, and make decisions [1]. Artificial intelligence has subsets, including Machine Learning (ML) and Deep Learning [2]. Machine Learning (ML) develops algorithms that help machines learn from past experiences [2]. Deep Learning utilizes multiple layers of algorithms in training systems [2].

The benefits of AI are many. It helps humans perform tasks more efficiently, thereby saving time and energy [2]. AI is a rapidly evolving technology that spans many spheres of life, including business, aerospace, defense, agriculture, entertainment, and medicine [2]. In orthopaedics, which is a branch of surgery, AI is currently applied preoperatively in virtual reality systems to aid surgical training and planning of surgical scenarios [3]. Intraoperatively, robotic systems enhance precision and provide real-time assistance during surgery [3]. Postoperatively, it helps predict surgical outcomes and provides real-time feedback on pain, movement, functional abilities, and rehabilitation problems [3].

In Low- and Middle-Income Countries, financial constraints and infrastructural deficits are common [4]. In addition, manpower shortages and geographical restrictions are major hindrances to accessing surgical care [4]. Artificial intelligence can potentially be important in improving outcomes and service delivery in this region, even though the application is still unclear [4, 5]. There is scanty information from literature search on how resource-poor regions can utilize AI in the management of musculoskeletal problems to solve problems peculiar to the region.

Owing to the heterogeneous nature of this subject and the limited number of studies in LMIC, a narrative review was chosen to identify the potential roles of AI in addressing orthopaedic care challenges in these settings. The study aims to identify the peculiar problems of the practice of orthopaedics in LMIC and suggest possible ways AI integration can solve them.

Scope and Search

A literature search was conducted in PubMed, MEDLINE, and Google Scholar to identify articles published through June 21, 2026. Search items included combinations of "Artificial Intelligence", "Orthopaedics", "Orthopaedics in Low and Middle-Income Countries".

Studies were eligible for inclusion if they focused on the role of artificial intelligence in solving the problems of orthopaedic care in LMIC. Articles not available in English were excluded.

Systematic reviews, clinical trials, scoping, and narrative review articles were eligible for inclusion. Articles were collected and uploaded into the reference management software Zotero, and duplicates were removed. After removing duplicates, the titles and abstracts of the documents were reviewed, and those that did not meet the inclusion criteria were removed. A total of 38 articles were found and screened for relevance, and 28 were selected and reviewed.

Thematic Sections

Defining characteristics of low and middle-income countries

According to the World Bank report of 2025, a country is classified as Low-Income or Middle-Income if the Gross National Income per capita is US$14,005 (£11,120) or less [4]. About 83% of the world population lives in LMIC [6].

The single most preventable trauma burden in these regions is road traffic accidents [6]. They account for 90% of global road traffic deaths, and 90% of the deaths in LMIC are due to inadequate resources for trauma care [6, 7]. Accessible roads are either non-existent or of low quality [6].

Trauma registries are usually poorly organized [6]. This can be due to either missing data or insufficient resources to maintain such [6]. These registries are repositories of data that can guide refinement of service delivery [6].

In resource-poor regions, the adoption of new treatment modalities has been hindered by religious and cultural beliefs [6]. The belief that disease is caused by an evil spirit is common [6].

About 90% of those who live in LMIC do not have access to appropriate surgical care [6]. There is a persistent migration of specialists (surgeons), which has contributed significantly to this problem [6]. Such migration could be attributed to a lack of appropriate facilities for practice [6]. Others have asserted that they migrate to have access to better training opportunities [6].

Problems of musculoskeletal care in low and middle-income countries

The practice of orthopaedics in LMIC is growing despite the challenges. Some problems of orthopaedic practice peculiar to LMIC are highlighted below.

Implants and equipment for fracture fixation are often lacking or inadequate [7]. The cost of implants for fracture fixation is high [7]. Patients in these regions are usually financially constrained and cannot afford these implants [7]. In addition, lack of access to grants and donations, as well as the lack of political will occasioned by poor leadership, have also contributed [7]. Furthermore, implant options are limited, and the available ones are poorly regulated [8]. Hardaker *et al.,* observed that only 44.5% of patients who met the indication for fracture fixation in Tanzania received surgical intervention [9]. In addition, up to 94% of orthopaedic patients sourced their implants from private suppliers [7].

There is a shortage of trained manpower. Orthopaedic surgeons are scarce in LMIC [10]. Whiting *et al.,* surveyed some trauma centers in LMIC and observed that 33% did not have trained pelvic/acetabular surgeons to manage pelvic/acetabular fractures. Training in Arthroscopy is poor because facilities for training are deficient [11]. Similarly, other multidisciplinary team members like radiologists, oncologists, and physiotherapists who are involved in the management of musculoskeletal disorders are also limited in number [12]. This hampers the delivery of proper surgical care to patients. For example, reporting of radiology images may not be prompt or accurate in certain regions because radiologists who are expected to do so are either unavailable or insufficiently skilled [12].

There is a lack of proper follow-up care for orthopaedic patients [13]. The problem may be at the individual level due to financial constraints, low literacy level, or where the desire to return for follow-up is absent [13, 14]. It can be at the community level due to a lack of effective means of transportation or due to travel restrictions [14]. It can be organizational due to problems of a non-standardized method of data collection or challenges in maintaining contact with the patient, as it relates to his physical address [14]. Insurance coverage, which obviates cost and facilitates patients' continuation of care, is also deficient, thereby worsening the situation [14, 15]. In these regions, patients stop attending follow-up clinics as soon as they can use their limbs again; visits are irrespective of radiological findings or medical advice [13]. Postoperative infection or functional impairment may ensue if follow-up instructions are not adhered to, and the Patient-Reported Outcome Measure (PROM) cannot be documented [8]. Such non-compliance with follow-up worsens surgical outcomes [13]. Young *et al.,* noticed that only 58% of patients with femoral fractures returned for follow-up as scheduled, but those with complications returned without being reminded [13].

There is a high burden of musculoskeletal conditions in LMIC [16]. Conflicts and disasters are common, and they increase the burden of orthopaedic conditions presenting to the surgeon [17, 18]. The workload becomes too much for the existing facility and personnel. Manual documentation of reviews can be time-consuming, and reporting standards can be inconsistent, thereby leading to errors [19]. Workload, ineffective documentation, long hours of work, and lack of sleep can lead to burnout [20]. O'Connor *et al.,* have noted the high rate of burnout among orthopaedic trainees in South Africa [20].

Adoption of electronic medical records is limited [4]. Perioperative data is poorly structured [4]. Paper documentation is still done in some regions [21]. Proper documentation ensures continuity of patient care from one visit to another, as well as the exchange of information from one healthcare provider to another [21]. Inadequate documentation results in unnecessary visits, unwarranted repetition of examinations or investigations, thereby increasing the cost of healthcare [21].

AI-driven solutions to the problems of musculoskeletal care in LMIC

AI has given a ray of hope towards addressing some of these problems. Even though some recommendations may still be in their developmental stages, they all appear promising.

AI models can be used to address shortages of implants and orthopaedic equipment [10]. By making use of historical and real-time data, they can predict the future need for an implant/equipment [10]. This makes institutions anticipate demand so as to make procurement decisions ahead of time [10]. Restocking can be done as and when due. This forestalls shortages while preventing overstocking [10]. Real-time inventory analytics prevent excess inventory and improve supply chain responsiveness [10]. Simulation models anticipate shortages, while AI-driven demand models reduce forecasting errors [10].

AI assistants can solve the problem of manpower scarcity. It is now possible to detect a fracture using AI [12]. Studies have shown that there is no statistically significant difference in the sensitivity and specificity of fracture detection with *X*-ray and Computerized Tomography scans compared to AI [12]. An AI-powered symptom assessment application can prepare a patient for consultation, thereby reducing the duration of consultation, while ensuring quality [22]. AI can be integrated into many point-of-care imaging systems, such as mobile *X*-rays [23]. Image generated from the exposure is analyzed using deep learning models to make a diagnosis. Such AI integration enables the shifting of tasks from specialists to non-specialists [23]. Studies have shown that about 65% of AI assistants perform as efficiently as specialists [23]. Rehabilitation services are also not left behind. In primary care, where physiotherapists are deficient, an AI-powered Clinical Decision Support System (CDSS) has been developed [24]. The system uses an AI case-based reasoning approach to recommend physiotherapy options to patients based on prior successful treatments [24]. AI can also achieve a seamless integration of multidisciplinary care wherever it is needed [12]. Furthermore, Simulation-based training is now possible with AI [12]. This can help specialists to upskill. The importance of such training was emphasized by Mart *et al.,* [25]. Arthroscopy training, which requires a long learning curve, can be made easier with AI simulation [25]. It has the added benefit of ensuring safety and reducing the risk to human life [25].

The burden of musculoskeletal trauma can be alleviated by making service delivery more efficient. Clinic documentation can be automated using Natural Language Processing, a subset of Artificial Intelligence [25]. This will enhance clinical workflows and reduce workload [19]. It can also provide decision support by suggesting possible management pathways [19]. AI-enabled triage systems can help streamline patient flow. Such systems can automatically schedule appointments, thereby reducing congestion [26]. They also enable patients to conduct self-triage and adjust their care-seeking behaviour based on the output generated [26]. Such symptom checkers have demonstrated performance comparable to humans [26].

Remote consultations can be integrated with AI to make follow-up consultations effortless [4]. With Natural Language Processing, real-time data analysis and decision support become possible during remote consultation [19]. After consultation, documentation can also be automated, minimizing errors [19]. The remote nature of this consultation also eliminates the physical barrier between the patient and caregiver and its inherent financial burden and other logistic concerns [19, 27]. AI-driven wearable devices can monitor patients' compliance with treatment and medical advice while at home [19]. AI-powered virtual assistants in the form of chatbots and intelligent systems can provide personalized care by alerting patients to take medications, schedule follow-up visits, or monitor vital signs [19,26]. They facilitate caregiver and patient matching and reduce the incidence of no-shows [26]. Furthermore, AI can be used to develop predictive models that detect high-risk cases. Such cases can be identified and prioritized during follow-up [4].

Automating data collection and documentation can improve medical record-keeping [28]. Natural Language Processing models can extract high-quality surgery-related and implant data from operation notes and clinical charts [28]. Data can be captured in real time from wearable devices and sensor-enabled implants [28]. Collection of semi-structured and even unstructured data, such as radiographic measurements and intraoperative alignment, is now possible with AI [28].

Limitations

Some articles relating to this topic may have been inadvertently omitted, thereby introducing publication bias. The paucity of published studies on this subject may also have limited our search.

Conclusion

The integration of AI in the care of orthopaedic patients is evolving. Its importance in addressing some problems exclusive to the practice of orthopaedics in LMIC cannot be overemphasized. Conducting more research within this field will accelerate this advancement.

Conflict of Interest

The authors declare that there is no conflict of interest.

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Contributors

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