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Artificial intelligence in scabies diagnosis

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Abstract

Scabies is an infectious skin disease caused by infestation of *Sarcoptes scabiei* var. *hominis*. Typical symptom of scabies is intense itching, especially at night, accompanied with a red, nodular skin rash. Scabies can be transmitted directly through skin-to-skin contact or indirectly through clothing, towels or bed sheets used by someone who is infected. Scabies is highly prevalent in environments where people live with close proximity such as Islamic boarding schools, dormitories, nursing homes and prisons. Since 2017, the WHO has classified scabies as one of the Neglected Tropical Diseases (NTD). The estimated global prevalence of scabies is between 100-200 million cases, with 455 million cases occurring annually. According to the Global Burden of Scabies Disease study in 2015, Indonesia ranked first for the highest number of scabies infections. Scabies is in the 3rd most common disease in Indonesia accounting for 5.77% of newly diagnosed skin cases. The highest prevalence of scabies in Indonesia was found in Islamic boarding schools, reaching 76.9% in 2019. Scabies had a prevalence of 6% -8.7% and ranked as the second most common skin diseases in the Dermatology and Venereology outpatient clinic at Saiful Anwar General Hospital Malang from 2014 to 2018.

Keywords: Infestation, transmitted, someone

Introduction

A much greater burden of scabies is found in low- and middle-income countries, where access to effective scabies treatment is often inadequate and limited, high population density also contributes to increased the transmission of scabies [7]. Scabies can be indirectly transmitted through clothing, towels and bed sheets that have been contaminated with scabies mites. According to Rizal et al. [8], poor personal hygiene is a significant risk factor for scabies particularly among students, highlighting personal hygiene as an important risk factors for scabies. Additionally, scabies can also be transmitted through sexual contact among adults and older individuals residing in long-term care facilities are particularly vulnerable to scabies. Considering these factors, rapid diagnosis and prompt treatment of scabies are essential for effectively eradicating scabies [7].

In 2020, the International Alliance for the Control of Scabies (IACS) established diagnostic categories aimed at simplifying the diagnosis of scabies. The diagnostic categories are divided into group A, namely confirmed scabies by finding mites, eggs or scabies on examination, group B, namely clinical scabies based on typical lesions (burrows or typical lesions affecting male external genitalia) or typical lesions in typical predilection areas with two positive history features (itching and contact with the source of infection) and group C, namely suspected scabies if lesions are found in typical distribution areas and one finding in a positive history or atypical lesions and distribution with two history features. However, accurately diagnosing scabies based solely on the IACS diagnostic criteria can be difficult and may require the expertise of a skilled physician or doctor [9]. Thus other additional supporting examinations are needed.

Scabies diagnosis can be done with several supporting examinations. The India ink test, also known as the burrow ink test (BIT), is a painless and simple diagnosis method, but has low sensitivity. Skin scraping with a scalpel can be done and the scraped material is examined under a microscope. However, this method is less well-tolerated in pediatric patients, because it causes pain and may require repeated scraping on different parts of the body [10]. Dermatoscopy and videodermatoscopy examinations allow for in vivo visualization of the skin, but due to the expensive cost and limited availability in healthcare facilities, they are rarely used.

A skin biopsy allows the discovery of mites and their eggs in the stratum corneum. Biopsy can confirm the diagnosis only when the mites or mite body parts are found through scraping ^[11]. In current practice, scabies is primarily diagnosed based on the clinical presentations. Due to the wide variety of skin diseases that can appear similar clinically, scabies is often misdiagnosed. Considering existing scabies supporting examinations still have shortcomings that can impact the diagnosis of scabies, additional support is necessary to help confirm the diagnosis of scabies.

Appropriate diagnostic approach is a key factor in reducing the prevalence of scabies and ensuring effective treatment. However up to 45% of scabies cases are estimated to be incorrectly diagnosed as another condition. Several factors contribute to the misdiagnosis of scabies are overlooking common clinical manifestations, difficulties in diagnosed the subtypes or identifying atypical presentations of scabies, inadequate physical exam and overlooked of nonpruritic lesions in scabies. Scabies lesions can mimic other skin disease with moderate to severe pruritus symptoms such as atopic dermatitis, popular urticaria and other contact dermatitis. Subtype of scabies include nodular, pustular and vesicobullous and crusted scabies contribute to high rate of misdiagnosis. Atypical lesion of scabies often appears in immunocompromised patients, such as scabies of the scalp coexisting with seborrheic dermatitis or dermatomyositis can be particularly challenging. Inadequate physical exam and overreliance on the clinical history can lead to misdiagnosis of scabies, often in the form of dermatitis as the cause of pruritic rash ^[12]. Additionally, the lack of recognition of scabies lesions, due to their similarity to other dermatoses and allergies, often leads to immediate initiation of anti-allergy treatments or antihistamines. Therefore, allowing the scabies mites to persist in the skin, worsening the spread of the infestation ^[13].

A quick and accurate diagnosis of scabies is needed to avoid scabies complications. The most frequent complications in patients with scabies are bacterial infections, especially those caused by *S. aureus* and *Streptococcus pyogenes* ^[14]. Secondary infections may trigger systemic complications such as kidney disease and rheumatic heart disease ^[6]. Misdiagnosis of scabies is one of the factors that can delay scabies treatment. Scabies patients in China experience misdiagnosis due to the distribution of the lesions resembling generalized eczema. Skin diseases such as eczema, atopic dermatitis, xerosis have typical symptoms of itching which can make clinical diagnosis quite difficult. Misdiagnosis of scabies can also occur because the distribution of lesions resembles eczema. In this study, nearly all patients had a symmetrical distribution of lesions on the back, trunk and abdomen and only around 50% of patients had lesions in the interdigitalis area. In addition, there has been a decreased in the prevalence of scabies cases over the last 20 to 30 years in China. This decline may have led physicians to rely heavily on textbooks and the lack of clinical experience, causing in reduced awareness of the diagnosis of scabies and increased likelihood of misdiagnosis ^[15]. Bonazetti et al. ^[14] also reported a case of Norwegian scabies in Italy caused by long-term steroid use due to misdiagnosis of scabies with atopic dermatitis. Norwegian scabies is an infrequent occurrence and if there are no typical lesions in classic scabies, Norwegian scabies is often overlooked.

Manifestations of skin diseases and brief dermatology training in medical schools make dermatological diagnosis quite challenging, especially for non-dermatologists ^[16]. This explains the need for clinical decision tools to aid physicians in diagnosis. The wide spectrum of skin diseases and their variety of presentations make this challenge ideally suited for AI-based clinical diagnostic tool. Artificial intelligence (AI) is generally defined as the ability of machines or tools to follow human intelligence. In the medicine, the more experience and data (information analysis) one has, the more possibilities to make better knowledge-based decisions. The data in question can be obtained from evidence-based medicine such as books and manuscripts published through peer review, while experience is obtained from real results of patient treatment including medical records, lab results and radiological examinations of patients ^[17].

The use of AI in diagnosis, prognosis and therapy has grown in recent years. The difference between traditional statistical analysis and AI is that AI utilizes data mining and pattern recognition capabilities to analyze structured and unstructured data. Structured data such as imaging, genetics, electrophysiology data are analyzed using machine learning algorithms and unstructured data such as electronic medical record, are evaluated using natural language processing techniques. Analysis of electronic medical records through AI can increase doctors' knowledge and increase the active role of patients ^[18].

Research on artificial intelligence in medicine has been carried out in several specialties, one of which is dermatology. In the field of dermatology AI is used in faster data processing to provide better and more reliable diagnoses. AI has the potential to support in diagnosing skin lesions and could be particularly valuable at the interface between primary and secondary care. This emerging technology offers an exciting opportunity for dermatologists, who are best equipped to explore its utility and ensure its safe and ethical implementation within healthcare systems ^[19]. The study by Esteva et al. ^[20] used a single convolutional neuron network (CNN), trained to form images using pixels and disease labels as input to classify various skin lesions. CNN has the same ability as dermatologists in classifying 9 categories of skin disease, skin cancer and its precursors with clinical image accuracy reaching 55.4%. Another study by Mendes et al. ^[21] which also used CNN in 12 skin cancers and benign and pre-malignant skin conditions achieved an accuracy of up to 78%. A study by Akyeramfo-Sam et al. ^[22] used web-based AI to detect the three most frequent skin diseases in Ghana, proving quite high accuracy of 88% in atopic dermatitis, 85% in acne vulgaris and 84.7% in scabies. This study established that AI can avoid the need of manual detection of skin disease and reduce the treatment and diagnosis time. Emam et al. ^[23] conducted a study on the use of AI in predicting long-term response to biologics in psoriasis patients proving that patients with early diagnosis and initiation of therapy without psoriatic arthritis have a 90% chance of continuing therapy.

In other medical fields such as oncology, AI influenced the detection and classification of breast cancer metastases, lung cancer and skin lesions. In the field of neurosurgery, AI influenced the diagnosis, pre-surgical planning such as tumor segmentation or epileptogenic zone localization and prediction of treatment outcomes. AI also influenced in

various radiological imaging such as risk assessment, detection, diagnosis, prognosis and response to therapy. AI also influenced the field of ophthalmology for ocular imaging such as fundus photos, tomography in several eye diseases^[18].

In Indonesia itself, the use of AI in the medicine sector is still growing. Wijaya et al [24] conducted a study applying AI for the classification of skin diseases using a web-based CNN method and produced quite high accuracy of 97% in identifying skin diseases. Bernolian et al.^[25] conducted a study on the development of AI and the biomarkers TNF-Alpha, VEGF-D and HB-EGF for early detection of congenital heart disease intrauterine diagnosed, proving that artificial intelligence has almost the same ability as a fetomaternal expert to diagnose CHD in the fetus. and better than the TNF-Alfa biomarker. Considering the diverse beneficial applications of AI in assisting medical diagnosis, physicians aim to integrate AI to achieve prompt diagnosis of scabies.

Given Indonesia's increasing cases of scabies and the critical issue of misdiagnosis mentioned before, one of our attending physicians Dr. dr. Dhelya Widasmara, Sp.DVE, Subsp. DT, FINS DV, FAADV, has developed a smartphone application based on AI to aid scabies diagnosis in Indonesia named INSERT. INSERT aims to facilitate the diagnosis of scabies in Indonesia so the individuals who are detected with scabies can immediately seek treatment at the nearest health facility to receive appropriate scabies management. In this application, user need to fill a form about scabies symptoms, history of similar symptoms, clinical manifestations and lastly take photos to diagnose. First trial of the INSERT application will be held in an Islamic boarding school.

Another challenge from AI is an over-reliance on AI system which may lead to failure in critical thinking tasks. We hope with the development of this AI-based app it can support physicians in establishing diagnosis without replacing the physician's medical expertise and logical competence. Machine learning of an image will never be 100% accurate and medical professionals will need to understand the inherent limitations of the system^[16]. Furthermore, dermatologic differential diagnosis is not solely reliant on pattern recognition, medical history often plays a crucial role in achieving an accurate diagnosis^[16]. We are confident with the growing use of AI into our daily lives, AI can become a valuable tool in medical practice, particularly in the case of scabies diagnosis.

Conflict of Interest

Not available

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