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Divergent Pathologies for Mental Disorders and Physical Illnesses: A Brief Comparative Overview and Implications for Artificial Intelligence Diagnostics

Ke Jiang*

Department of Medicine, Wenzhou Medical University, Wenzhou, China

***Corresponding author:** Dr. Ke Jiang, Department of Medicine, Wenzhou Medical University, Wenzhou, China, E-mail: jiangke@wmu.edu.cn

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Description

Mental disorders and physical illnesses, although both crucial aspects of human health, have distinctly different diagnostic pathologies [1]. The distinction between these two domains has significant implications for the approaches used by healthcare professionals to diagnose, treat and manage these conditions. Understanding these differences is essential for the development of effective diagnostic and therapeutic strategies tailored to each domain. In the following, we will outline diagnostic methods that compare mental disorders with physical illnesses.

Mental disorders are characterized by disturbances in an individual's cognitive, emotional, or behavioural functioning, often resulting from a complex interplay of genetic, environmental, physiological, and socio-cultural factors. The Diagnostic and Statistical Manual of Mental Disorders (DSM-5) provides guidelines for diagnosing mental disorders, such as Major Depressive Disorder (MDD), based on subjective experiences and qualitative descriptions that are difficult to objectively quantify and standardize [2]. In many cases, these guidelines rely on patient self-report of symptoms and clinical interviews, which can introduce subjective bias and lead to diagnostic inconsistencies [3]. In contrast, physical illnesses, such as pneumonia, are often caused by specific pathogens or physiological dysfunction, making their aetiology more identifiable and thus more amenable to targeted treatment strategies. Diagnostic criteria for physical diseases typically include a combination of clinical signs, symptoms, medical history, physical examination and diagnostic tests such as imaging and laboratory tests. These objective measures provide more definitive evidence of the underlying pathology and allow for more precise diagnosis and treatment decisions.

The presence of biomarkers is another key difference between mental and physical disorders. While there are no clinically useful diagnostic biomarkers for many mental disorders such as MDD, physical illnesses often have identifiable biomarkers that can be detected by laboratory tests, such as the presence of bacteria or viruses in sputum cultures for pneumonia. This difference may affect the reliability and validity of diagnoses and the selection of appropriate treatments.

Co-morbidities are common in both mental and physical health, but may be more challenging to diagnose in mental disorders because of the high degree of symptom overlap and the subjective nature of diagnosis. In contrast, co-morbidities in physical conditions, although present, are often easier to distinguish due to more specific and objectively measurable symptoms.

The presentation and course of the disorders are also important factors in distinguishing mental disorders from physical illnesses. Mental disorders such as MDD can have episodic and fluctuating symptoms, making diagnosis and treatment more complicated [4]. On the other hand, physical illnesses tend to have more consistent and stable symptoms over time, which can make the diagnostic process easier.

In addition, the aetiology of MDD involves a complex interplay of genetic, environmental, physiological and socio-cultural factors [5]. In contrast, pneumonia is often caused by specific pathogens, making it easier to identify a cause and choose appropriate treatment.

Factors	Mental disorders (MDD)	Physical diseases (Pneumonia)
Diagnostic indicators	Heavily reliant on subjective evaluation, based on patient's self-reported symptoms and clinical interviews	Primarily dependent on objective observation, including physical examination, imaging, and laboratory tests
Symptoms	Vary greatly among individuals, making diagnosis more challenging	Typically more consistent and specific, allowing for easier identification
Biomarkers	Limited or no clinically useful diagnostic biomarkers	Presence of diagnostic biomarkers, such as bacterial or viral presence in sputum culture
Co-morbidities	High prevalence of co-morbid mental disorders, complicating diagnosis	Co-morbidities exist but are often easier to distinguish due to more specific symptoms
Symptom presentation	Symptoms can be episodic and fluctuating, complicating diagnosis and treatment	Symptoms are generally more consistent and stable during the disease
Aetiology	The complex interplay of genetic, environmental, physiological, and sociocultural factors	Often due to specific pathogens, making it easier to identify a cause and choose an appropriate treatment

Table 1: Comparing diagnostic approaches: mental disorders (major depressive disorder) *vs.* physical diseases (pneumonia).

Recently, AI has been recognised for its significant potential in diagnosing diseases. However, the use of AI to diagnose mental and physical disorders may differ due to the nature of the disorders and the

data available. Traditional diagnostic approaches for mental disorders are primarily based on linguistic analysis, which can be influenced by individual experience and differences in physician skills. Advanced Natural Language Processing (NLP), on the other hand, has the potential to analyse vast amounts of textual data from patient interviews, self-reports and clinical notes, enabling more consistent and objective assessments. By harnessing the power of AI, NLP can identify subtle patterns and correlations in patient's language and symptom descriptions that may be difficult for healthcare professionals to detect manually. This can lead to improved diagnostic accuracy, faster identification of appropriate treatments and more personalised care. Recently, LLMs such as GPT-4 have shown great promise in significantly improving the diagnosis of mental disorders. Within a symptom-based diagnostic system, LLMs can efficiently establish robust links between subjective qualitative descriptions, symptoms, and mental disorders. In particular, fine-tuned Chat GPT can skillfully extract semantic information from patients and semantically align it with established diagnostic criteria, such as those found in the DSM-5. This approach enables precise matching of diagnostic criteria to specific disorder categories, greatly facilitating automated consultations for mental health issues. Incorporating GPT into the mental health diagnostic process opens up new opportunities for better patient engagement and communication. For physical conditions, AI may focus more on pattern recognition in medical imaging or analysis of laboratory results.

In mental health, AI systems may face challenges in interpreting subjective and qualitative descriptions from patients and medical professionals, as well as behavioural patterns [6,7]. Subjective data in mental health can be influenced by a variety of factors such as cultural context, patient bias, and the nature of the illness itself, making it more difficult for AI systems to accurately decipher and utilise this information. In contrast, physical illnesses often involve more objective and quantifiable data (e.g. lab results, imaging, vital signs), which may be easier for AI algorithms to process [8]. The availability of standardised and consistent data in the field of physical illness enables AI systems to learn more effectively, identify patterns and make accurate predictions [9]. As a result, AI applications in the diagnosis and management of physical diseases have shown significant progress and potential for improved patient outcomes.

AI systems designed to diagnose mental disorders face the challenge of accounting for the high variability in symptom presentation among individuals. Mental disorders, such as major depressive disorder, can manifest differently from person to person, with symptoms varying in intensity, duration, and frequency [10]. This heterogeneity requires AI systems to be more adaptive and sensitive to individual nuances in order to accurately diagnose and manage mental health conditions. In contrast, physical illnesses tend to have more consistent and specific symptoms, making it easier for AI algorithms to identify patterns and recognise the illness. This consistency allows AI systems to be more efficient and accurate in diagnosing and monitoring physical conditions, as they can rely on more standardised data and objective clinical markers.

In mental health, AI systems need to be cautious when suggesting diagnoses and treatment options, as the data they rely on can be inherently subjective and prone to bias [6]. Patient-reported symptoms and clinical notes can be influenced by personal experiences, cultural factors, or individual interpretations, which can complicate the diagnostic process. Furthermore, the lack of definitive biomarkers for many mental disorders contributes to uncertainty in diagnosis and treatment recommendations. Therefore, AI systems need to be designed with a more comprehensive approach that accounts for these potential biases and subjectivity in order to provide reliable and accurate suggestions (Tables 1 and 2).

Factors	Mental disorders	Physical diseases
AI techniques	Relies on Natural Language Processing (NLP)	Focuses on pattern recognition in imaging and lab tests
Data interpretation	Challenges in interpreting subjective and qualitative data	More objective and quantifiable data to process
Symptom presentation	High variability in symptom presentation among individuals	More consistent and specific symptoms
Diagnostic confidence	Greater caution due to subjectivity and potential biases	Increased confidence due to objective data

Table 2: Comparing diagnostic approaches when using AI: mental disorders *vs.* physical diseases.

In contrast, AI systems for physical diseases can benefit from more objective data, such as lab results and medical imaging, which allows for greater confidence in diagnosis and treatment recommendations [8]. The availability of more objective data allows AI algorithms to make more accurate predictions and provide more informed treatment options, ultimately improving patient outcomes.

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