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Review Article

"Precision Psychiatry: Tailoring Mental Health Treatments to the Individual"

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Abstract

Precision medicine, propelled by genomic advancements, is transforming the healthcare landscape by transitioning from traditional evidence-based methods to individualized care. Despite originating from personalized care roots, psychiatry has been hesitant in embracing this approach compared to disciplines such as oncology and haematology. Objective: This paper aims to assess the present status of precision psychiatry, with a focus on prognostic models utilizing clinical and biological data, while also addressing obstacles and future paths. Methods: By amalgamating insights from recent research and programs, including the Precision Medicine Initiative in the United States, this article underscores the amalgamation of genetic, neuroimaging, and other biological data into psychiatric practice alongside advancements in data analysis methods like machine learning. Results: While oncology and haematology have advanced in precision medicine, psychiatry lags behind. Prognostic models using clinical and biological data show promise, but implementing pharmacogenetic breakthroughs is complex. Current efforts focus on identifying biological markers and clinical variables for personalized therapy, with significant findings still in progress. Discussion: The integration of precision medicine in psychiatry is challenged by the need for precise terminology, methodologies, and validated biological markers. Addressing psychiatric disorders requires a dynamic, longitudinal approach considering developmental trajectories from childhood. Preventative strategies through combining omics data with neuroimaging and phenotypic information hold significant promise. Conclusion: Precision psychiatry aims to revolutionize mental health care by customizing treatments to individual patient characteristics. Despite slower adoption compared to other fields, advances in data analysis and large-scale programs are driving progress. Overcoming current challenges and incorporating longitudinal approaches are key to its future success.

INTRODUCTION

Coinciding with the completion of the human genome sequencing and the consequent elucidation of the genetic structures of numerous intricate diseases, precision medicine has emerged as a new and encouraging entity in the realm of healthcare[1]. Despite the constant increase in its acceptance among healthcare providers, recipients, as well as public and private stakeholders over the past decade, a comprehensive grasp of its attributes and operational methodologies remains somewhat restricted [2]. There is a consensus that precision medicine is causing a shift in the clinical care paradigm from a conventional, evidence-based approach—founded on data acquired from extensive populations—to a personalized, profound comprehension of clinical (phenotypic) and biological traits [3]. Nevertheless, precise depictions of the potential repercussions of precision medicine on healthcare, particularly in economic dimensions, are still scarce[4]. Generally, precision medicine emphasizes tailoring care to the individual and accentuates the distinctive features of each patient, aligning with the conventional, clinically inclined approach that has traditionally characterized the field of medicine[5].

Psychiatry serves as a prime example of the possibilities offered by a customized clinical strategy [6]. Its basis in descriptive psychopathology and phenomenology emerges from a meticulous scrutiny and grasp of the internal irregular processes exhibited by individuals [7]. Despite its origins in individualized care, psychiatry has been slow to embrace precision medicine, which integrates supplementary sources of data like neuroimaging and biological metrics [8]. Specialties such as oncology and hematology have made notable progress in the realm of precision medicine. Instances include the SHIVA trial in oncology and the endorsement by the FDA of CAR T cell therapy in hematology, which demonstrate the potential of tailored interventions crafted based on individual biological attributes.

Conversely, advancements in precision psychiatry have been sluggish. Initial endeavors, such as the dexamethasone suppression test, displayed promise but encountered hindrances in clinical effectiveness due to shared characteristics among various severe psychiatric conditions [9]. This underscores the obstacles in incorporating precision medicine in psychiatry. Moreover, the necessity for precise terminology and methodologies in precision medicine, especially within psychiatry, is pivotal.While the concept of statistical significance is well-established, clinical significance remains ambiguous, often hinging on subjective interpretations[10].

Recent progressions in data analysis techniques, like machine learning, have commenced tackling this issue by enabling deductions from nonlinear correlations and limited sample sizes [11]. These methodologies have proven beneficial in constructing clinically pertinent predictive models, which are imperative for the progression of precision psychiatry [12]. This review will delve into the notable discoveries in precision psychiatry, concentrating on predictive models

grounded in clinical and biological information, examining current obstacles, and contemplating future outlooks.

THE SIGNIFICANCE OF PRECISION MEDICINE IN PSYCHIATRY.

Precision medicine is an idea that is currently picking up speed across all areas of healthcare. Specifically, in psychiatry, it is urgently required due to the significant economic impact of mental health conditions and, primarily, because of the extended period required to see positive effects from therapies and the wide range of responses to treatments.

FUTURE FOUNDATION: RELIANCE ON BIOLOGICAL DETERMINANTS.

The detection of biological markers and clinical factors for tailoring treatments has been suggested as a method for precise individual treatment planning, showing great promise[13]. In the United States, a significant research endeavor known as the Precision Medicine Initiative is underway to achieve this objective[14]. By enrolling one million participants and gathering both clinical and biological data, this initiative aims to uncover distinct treatment patterns for various illnesses, including mental health disorders and depression [15]. The identification and validation of biological markers is intricate, and the existing commercial products are viewed as preliminary in this regard [16].

Upon full establishment, the integration of these markers into routine clinical practice will be pursued. Nevertheless, until the realization of this compelling yet distant aim, our prescription decisions will primarily rely on clinical traits[17]. Notably, these clinical factors are a valuable resource, although their consistent and appropriate application in medical contexts is lacking[18]. The forthcoming sections aim to outline the essential considerations for prescribing antidepressant treatments, with the objective of achieving the utmost level of precision medicine attainable using clinical data [19].

DETERMINING THE MOST EFFECTIVE ANTIDEPRESSANT

Both patients, as illustrated in the initial segment of the text, and healthcare providers aspire to identify the most efficacious antidepressant for treatment. The resolution of this precision medicine challenge would involve administering the most potent antidepressant to all individuals[20]. Regrettably, such a universal solution does not currently exist. Recent years have witnessed numerous investigations striving to pinpoint the most effective antidepressants, including a notable network meta-analysis from a few years back. This analysis ranked all antidepressants based on their efficacy and tolerability, though some reservations were raised regarding the findings[21]. Clinical practice commonly acknowledges the absence of a universally superior antidepressant, as each medication possesses a distinct efficacy and tolerability profile grounded in its unique pharmacodynamic properties [22]. For instance, while mirtazapine emerged as one of the most effective antidepressants in the study by Cipriani et al., its specific pharmacodynamic characteristics lead to sedation and weight gain in a majority of individuals. Consequently, mirtazapine

may not be suitable for individuals with atypical depression characterized by hypersomnia and increased appetite[23]. In light of this, the quest for the most effective antidepressant continues, necessitating additional criteria for selecting the appropriate medication[24].

STEPS FOR DEVELOPING HIGH-QUALITY, CLINICALLY BASED PRECISION MEDICINE

Unfortunately, due to the absence of clear guidelines and the lack of highly effective compounds, some healthcare providers may resort to prescribing based on personal judgment and subjective experiences. This practice starkly contrasts with the principles of evidence-based precision medicine and should be actively discouraged. Consequently, it is imperative to make decisions based on alternative evidence-based criteria.

The primary criterion to consider is the patient's previous response to treatment: if an individual has previously benefited from a specific medication, this represents a robust rationale for prescribing the same medication again[25]. In cases where such information is unavailable, one can look at responses within the same family. Given that first-degree relatives share 50% of their genetic makeup, a positive response to a certain medication in a first-degree relative can also strongly support the decision to prescribe the same medication, unless there are contraindications present[26]. Another crucial set of criteria involves evaluating potential pharmacokinetic and pharmacodynamic interactions[27]. The majority of medications can influence the activity of CYP enzymes to varying extents, leading to fluctuations in the plasma levels of concurrent medications or the medication itself, which could result in toxicity or other adverse effects stemming from artificially altered plasma concentrations. Additionally, pharmacodynamic interactions must not be overlooked; for instance, the combination of certain medications with many antidepressants may increase the risk of bleeding. Hence, it is recommended to assess both types of interactions using online resources such as web tools[28].

FUTURE DIRECTIONS AND POTENTIAL OF PRECISION MEDICINE IN PSYCHIATRY

We have posited that precision psychiatry is rooted in precise deep phenotyping. Nonetheless, this can solely be accomplished through a comprehensive consideration of a dynamic longitudinal viewpoint[8]. Evidently, numerous severe psychiatric conditions exhibit developmental paths that commence in childhood or early adolescence[29]. The origins of these conditions encompass not only psychopathological elements but also neurocognitive, neuroanatomical, and biological factors. In this regard, precision psychiatry may also hold a preventive significance. The amalgamation of omics methodology with neuroimaging and phenotypic information has the potential to enhance the precision in prognosticating diagnostic transitions in high-risk populations[30]. Efforts to implement these methodologies have been undertaken in populations identified as clinically high-risk for psychosis[31]. Nevertheless, the longitudinal aspect in psychiatric conditions continues to be disregarded. This is particularly pertinent when considering that genetic correlations with a

particular disorder may vary based on diverse trajectories or antecedent patterns[32]. Even within well-defined phenotypes like lithium response, there exists limited understanding of the temporal dynamics of neurobiological alterations that underlie the initiation of prolonged treatment effectiveness[33]. Furthermore, it remains to be determined whether immediate neurobiological changes correspond to enduring alterations and if the latter can be predicted from the former. In this setting, an ongoing extensive research initiative funded by the European Union endeavors to address this critical research and clinical inquiries. Alternate methodologies, once again employing a longitudinal standpoint, are striving to unravel the interplay of various biological elements, including the microbiome, in the vulnerability to recurrences in bipolar disorder. In summary, the potential for precision psychiatry is substantial, but can solely be actualized by incorporating the temporal dynamics of mental disorders[34].

CONCLUSION

Precision psychiatry has the potential to revolutionize mental health treatment by customizing interventions based on each patient's unique characteristics. Despite originating from personalized care, the field of psychiatry has been relatively slow in adopting the precision medicine approach compared to disciplines like oncology and hematology. The incorporation of genetic, neuroimaging, and other biological data into psychiatric practice has encountered significant obstacles, including the necessity for proper terminology, methodology, and the translation of pharmacogenetic discoveries into practical treatment strategies.

Recent progress in data analysis, particularly in the realm of machine learning, presents promising avenues for constructing predictive models that can enhance precision psychiatry. These models can effectively tackle the challenges posed by non-linear correlations and limited sample sizes, which are frequently encountered in psychiatric investigations. As the field progresses, the amalgamation of biological markers with clinical parameters is anticipated to offer a more holistic method for tailoring treatments to individuals.

Present endeavors, such as the Precision Medicine Initiative in the United States, strive to amass extensive clinical and biological information to pinpoint effective treatment patterns. Nevertheless, until these large-scale initiatives produce actionable insights, clinicians must depend on clinical features and historical response patterns to inform treatment choices. This highlights the necessity for a dynamic, longitudinal outlook in comprehending psychiatric conditions, which often exhibit developmental trajectories commencing in childhood or adolescence.

The future of precision psychiatry hinges on fusing omics data with neuroimaging and phenotypic details, potentially leading to preventive advantages by identifying vulnerable populations. As research endeavors persist in investigating the interplay of diverse biological elements and their implications on mental well-being, the aspiration of achieving genuinely personalized care becomes progressively feasible. Precision psychiatry holds the promise of enhancing treatment outcomes, lessening the societal burden of psychiatric ailments, and amplifying the overall efficacy of mental healthcare.

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