A Brazilian bottom-up strategy to address mental health in a diverse population over a large territorial area – an inspiration for the use of digital mental health

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ABSTRACT

Brazil is a continental country with a history of massive immigration waves from around the world. Consequently, the Brazilian population is rich in ethnic, cultural, and religious diversity, but suffers from tremendous socioeconomic inequality. Brazil has a documented history of categorizing individuals with culturally specific behaviors as mentally ill, which has led to psychiatric institutionalization for reasons that were more social than clinical. To address this, a "network for psychosocial care" was created in Brazil, that included mental health clinics and community services distributed throughout the country. This generates local support for mental health rehabilitation, integrating psychiatric care, family support and education/work opportunities. These clinics and community services are tailored to provide care for each specific area, and are more attuned to regional culture, values and neighborhood infrastructure. Here we review existing reports about the Brazilian experience, including advances in public policy on mental health, and challenges posed by the large diversity to the psychosocial rehabilitation. In addition, we show how new digital technologies in general, and computational speech analysis in particular, can contribute to unbiased assessments, resulting in decreased stigma and more effective diagnosis of the mental diseases, with methods that are free of gender, ethnic, or socioeconomic biases.

1. Introduction

Determinant factors for mental disorders, or, alternatively, promoters of mental health, are not solely characterized by genetics or individuals' interactions with their own thoughts, emotions, and behavioral reactions, but also by the environmental context in which the individual is embedded. Territorial constraints, which include social, economic, and cultural determinants, generate an extensive range of environmental pressures that can have strong influences in shaping behavior (Lund et al., 2018) (World Health Organization, 2021). These environmental components are complex, and need to be considered, to avoid unconscious biases by mental health professionals, who need to comprehend the local culture to recognize mental suffering even when treating patients who have very different backgrounds from their own.

Understanding the substantial impact of each social determinant in mental health is a difficult task. Many interact within the same group of people (Lund et al., 2018) and are perpetuated through generations, creating a history of social exclusion that contributes to mental suffering. The present review focuses on the Brazilian experience, and solutions designed to cope with environmental factors in a large and diverse country. We will first describe the complex social determinants of mental suffering, focusing on the diversity of the Brazilian population, then on the rationale underlying "RAPS", a community-based network of mental health services based on the promotion of psychosocial

rehabilitation, its achievements, and challenges, give a couple of specific examples of diverse populations, and conclude with possible technological solutions.

2. Challenges in addressing mental health in a diverse country

Brazil is a country with a continental territory that has received massive immigration waves throughout its history. The initial colonization by Europeans began in 1500 when the native population was composed of a variety of Amerindian groups estimated at 2.4 million (Carvalho-Silva et al., 2001 IBGE, 2007;), that was subsequently reduced considerably because of wars, indigenous slavery, and imported infectious diseases (IBGE, 2007). This was followed by a massive forced immigration of African people brought as slaves, initially to work in the sugar cane plantations. The estimated total number of slaves brought from Africa to Brazil is around 4 million, though a majority did not survive more than seven years due to the unhealthy work conditions (Carvalho-Silva et al., 2001 IBGE, 2007;).

In the 19th century, following the liberation of the slaves (in 1888), the government stimulated immigration to replace slave labor, and there was another influx of Europeans, mostly to the South and Southeast regions of the country (Levy, 1974). Most recently, in the 20th century, immigration waves increased from other European countries, as well as from Japan, Syria, and Lebanon (Carvalho-Silva et al., 2001 IBGE, 2007; Levy, 1974;). This racial and cultural diversity generated regional disparities in a population that nonetheless has the same national identity, and resulted in a large, diverse, and economically unequal country that concentrates its wealth in southern urban areas, building the roots of structural racism in Brazil (Soifer, 2014).

Understanding the historical roots of racism against African and Amerindian descendants allows us to comprehend how social determinants of mental suffering can severely impact a specific group of people with more exposure to discrimination over generations. We considered here the framework of social determinants of mental suffering proposed by (Lund et al., 2018), which includes five domains: demographic (including racial diversity), economic, local conditions, environmental events (such as violence, natural disasters, wars), and social-cultural aspects. For example, descendants of African slaves did not benefit from the country's economic growth, had their culture marginalized, lived in poorer areas, were more exposed to violence, and had scarce access to social security, including education and health care in general.

The impact on mental health is clear. For example, a representative national survey with more than 12,324 participants covering the five geographical regions of Brazil revealed an 80% increase in risk for depression for individuals that experienced racism in life (Pavão et al., 2012). Another extensive survey of 1953 participants in the town of Campinas (Southeast region, state of São Paulo) found that racism was associated with a higher incidence of mental disorders in general, even when controlled by other significant social determinants such as poorer educational level or socioeconomic status (Fernandes et al., 2020). To make matters worse, those self-assessed as black participants declared less access to mental health services (Fernandes et al., 2020).

How can those challenges be addressed in such a large and diverse country? A solution implemented in early 2000s was a substitutive model of the former hospital-centric care for a communitarian mental health assistance that aimed to promote social inclusion. It is based not on a single homogeneous service but in a network of mental health care and services, all of which focus on local determinants of mental suffering.

3. A network of mental health services adapted to the diverse Brazilian territories

The implementation of mental health care that aims to improve not only the symptoms but also the quality of life of patients, requires social inclusion and the commitment to human rights (World Health Organization, 2021). Strategies that enable social rehabilitation are those that provide social integration opportunities, respecting the local culture that mirrors its inhabitants (Santos, 2002). (Santos, 2002)(Santos, 2002)(Santos, 2002)Worldwide, the implementation of community-based mental health systems has provided person-centered and recovery-oriented services that improve quality of life. Integral to this approach, are human rights standards, such as access to education, employment, housing, and social benefits (World Health Organization, 2021). The Brazilian solution considered the importance of cultural values of the local population.

3.1. RAPS (network for psychosocial care)

Given the complexity of the Brazilian population and the geographical expanse of the country, the need for an organized mental health system that incorporated environmental factors, and that identified regional, culturally diverse groups was urgent. After decades of public debates against the institutionalization of people with mental health issues, an anti-asylum law was passed by the government to protect the human rights of those in mental distress (Gabriel and Delgado, 2020). This resulted in the creation of the "network for psychosocial care" or **RAPS** (from Portuguese, "**R**ede de **A**tenção **P**sicos**s**ocial"), a network of diverse mental health services that takes into account the needs of specific regions, and that permits the integration of mental health care and rehabilitation within the environmental diversity (Fig. 1). Central to the RAPS are the Centers for Psychosocial Care (**CAPS**, from Portuguese, "**C**entro de **A**tenção **Ps**icossocial"), which directly service a determined area and its inhabitants, connecting and integrating all the local resources (Fig. 1). These centers (CAPS) already existed before the implementation of the RAPS, but were not federal public policy, and were significantly expanded after the RAPS became official. The RAPS adopted the concept of "territory" to refers to delimited regions, that is, geographical area with its natural limits, but functionally it expands to include the human activities that dynamically change it (Santos, 2002). Within the public mental health policy, a territory is understood as a set of sites for social interaction based on social, political, affective and ideological relations (Fig. 1).

Thus, the RAPS is a network of devices and services directly linked to primary health care based on territories (Fig. 1). This network allows mental health professionals to understand the social determinants of each territory, and recognize the historical, cultural, racial, and social context of its population. These strategies permitted the creation of psychoeducational programs for patients and families that preserved their cultural references.

Moreover, the RAPS was designed to allow a seamless flow of care depending on the severity of mental suffering: from the primary care level (clinical, and not specialized in mental health), progressing to mental health community centers (secondary care level, CAPS), continuing all the way to hospitalization in community services or general hospitals (tertiary care level). The aim is to progressively replace the hospital-centric model as the only solution for mental health crises. (Amaral et al., 2018 Krachenski and Furtado Holanda, 2019; Lima Bezerra et al., 2014;)

3.2. Mental health services included in the RAPS

At the primary care level, the idea was to create interactions between the communitarian clinical services (such as **UBS**, from Portuguese, "**U**nidade **B**ásica de **S**aúde"), with specialized mental health professionals to support them on the assistance of stable but chronic patients, or mild cases of mental suffering. For that purpose, **NASF** (from Portuguese, "**N**úcleo **A**mpliado de **S**aúde da **F**amília") was developed, composed by special team of mental health professionals who support the communitarian services, strengthening the link between primary and secondary care (Gabriel and Delgado, 2020).
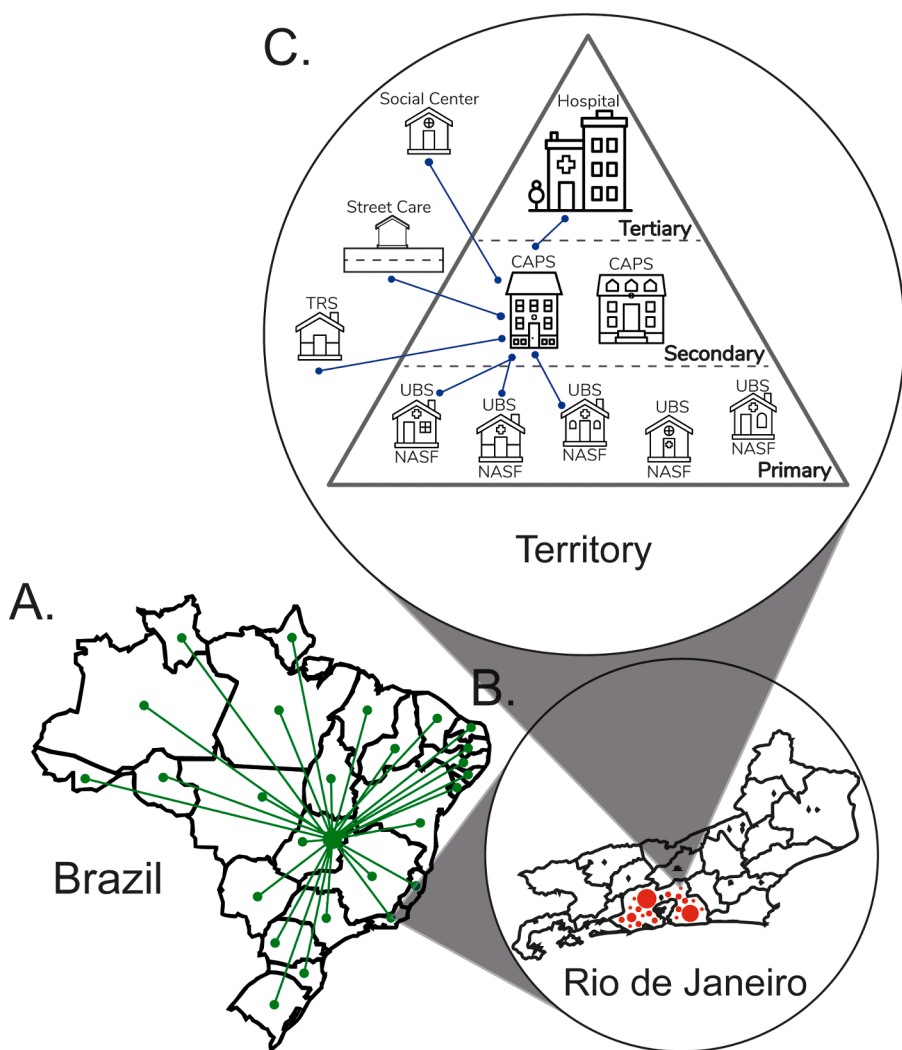
A secondary care solution was developed within RAPS to host those patients in need of specialized care, the psychosocial attention centers, or CAPS. These services are located mostly in regular houses or buildings to avoid the association with hospitals. The social inclusion programs involve all professionals at the service, who also share this responsibility with the family (Santos V and Martins T, 2016). The aim is to promote a social network around the patient. Any contact that links the patient with society is welcome to this process, which formulates an individualized therapeutic plan considering each patient's social background. Together, professionals, patients, and families develop aims (such as education, work, social security, etc.), then implement strategies to reach them. This type of intersectional mental health treatment was further developed to include child and adolescent mental health, as well alcohol and other addictions, with the clinical services expanding into a network of other services of a non-clinical nature, such as schools, sports institutions, leisure, culture, justice and social assistance agencies, tutelary advice (Gabriel and Delgado, 2020). (Centifanti, 2017)

The tertiary care is mostly directed at crisis management or for when hospitalization is needed, and services are rendered in general hospitals or in specialized CAPS with infrastructure that allows for hospitalization. The central idea is to avoid long-term hospitalization. The clinical team in the tertiary care coordinates with family and other social relations necessary for the patient's recovery, with the aim of allowing the patients to return to regular social routines as soon as possible.

Another important service aims to provide housing for those without family support and with no personal autonomy, called **T**herapeutic **R**esidential **S**ervices (**TRS**), refers to residential settings for chronic and institutionalized patients. Most are located near a CAPS, and are administrated by mental health professionals, with the CAPS providing the specialized care to promote psychosocial rehabilitation. Other programs integrated to primary and secondary care are also included in the therapeutical planning, such as "Social Centers", places to promote regular events, meetings, cultural activities, and "Street Care Services", to provide access to the homeless and drug addict population.

4. RAPS impact on social inclusion of vulnerable populations

Twenty years after the official implementation of RAPS, there is evidence that this policy has created positive change and is well-viewed by the population (Costa et al., 2015) (Luzio and L'Abbate, 2009). There has been a demonstrable transition from long-term hospitalizations to community mental health management, including crises management even at the level of primary care services, leading to a decrease of untreated psychosis, (for example (Thiesen et al., 2021)). During the first 10 years of implementation, there was a reduction of more than 20.000 beds for long-term hospitalizations, while there was a significant increase of communitarian services such as CAPS (from 148 to 1742 around the country), mostly located in smaller cities in rural settings. For example, cities with 20–50 thousand inhabitants that earlier received only 13.9% of all the CAPS implemented in the country, increased their share to 31.18% of all the CAPS in Brazil (Gabriel and Delgado, 2020). Overall, the change of the hospital-centric perspective

to a community-based model improved the adherence to treatment and pursuit of social recovery (Leão et al., 2021). Patients and families were included in the diagnosis and treatment, and mental health professionals were trained to discuss observations of patient in daily routines, integrating users' demands (Leão et al., 2021). This approach breaks the common cycle of patients not being considered as individuals and contributes to trust and adherence to long-term treatment (Leão et al., 2021). In addition, it leads to social inclusion through work, arts and local culture (Amarante and Torre, 2018). Over time, the client population witnesses their social inclusion, understands their rights, and this promotes positive social change in the territory (Pitta et al., 2015).

A great benefit of these movements has been the reduction of the stigma related to mental illness. Stigma is fostered by a culture that considers people with mental illness to be a menace that needs to be kept apart from society until complete remission of their symptoms (Salles and Barros, 2013a). Although it takes time to implement lasting cultural changes, as social inclusion is promoted by the sum of a series of little inclusion opportunities over time (Salles and Barros, 2013b), qualitative studies have shown improvement in social acceptance mediated by CAPS in different regions of Brazil (Rosa and Campos, 2013 Salles and Barros, 2013a;, 2013b Santos V and Martins T, 2016;). Clique ou toque aqui para inserir o texto.Also, higher levels of education, information about the services, and having a family member who needs mental health care were factors associated with positive attitudes towards resident users, helping reduce stigma (Tostes et al., 2020).

Art has become one of the most important cultural and psychosocial rehabilitation tools helping recover individual self-esteem (Amarante and Torre, 2018 Tavares et al., 2013;). It has brought changes to the way society understands "madness" and diversity (Amarante and Torre, 2018, 2017). Although large scale changes are still ongoing, local implementation of art programs is already in motion in the different regions of Brazil (Ortega and Wenceslau, 2020 Portugal et al., 2018; Tavares et al., 2013;). Moreover, the critical effect of cultural creation with personal references to individual self-esteem enables the design of therapeutic tools based on cultural expression (Portugal et al., 2018 Tavares et al., 2013;).

However, there is still much room for improvement, and it takes time to change mental health biases. First, there are primary care service providers that resist treating mental health patients (dos Santos and Bosi, 2021), creating barriers to transferring stabilized cases from higher care back to primary care services due to stigma. Second, although there was a clear increase in access to mental health services in rural areas (Gabriel and Delgado, 2020), there is still a lack of secondary and tertiary care infrastructure, due to the poor and unequal coverage around the country (Costa et al., 2015 Sousa and Jorge, 2018;), with less coverage of smaller cities in low populated areas in the Amazonian and centre-West regions (Gabriel and Delgado, 2020). Third, comparing the infrastructure implemented in Brazil with that of other countries that also adopted communitarian mental health services, it is clear that there needs to be an increase in federal investments. To illustrate, the TRS program implemented 106 therapeutic residences in the state of Rio de Janeiro alone (Costa et al., 2015), which is located in one of the richest regions of the country. These residences provide 0.37 vacancies per 10, 000 inhabitants. This is still much lower than what is available in some European countries such as Netherlands (5.3 vacancies per 10,000 inhabitants) and Italy (2.9 vacancies per 10,000 inhabitants) (Costa et al., 2015 World Health Organization., 2008;), but it is still much higher than in other parts of the country.

In summary, there has been improvement in services that has had considerable benefits for the population, but there is still need of overall infrastructure improvement, better distribution of the resources according to the population needs, and discussion of stigma and social determinants of mental health with multidisciplinary teams at different levels of mental health care in each territory (Costa et al., 2015)(Sousa and Jorge, 2018)(Luzio and L'Abbate, 2009).

5. Examples of especially vulnerable populations in Brazil

If the constant neglect of cultural references (linked to religion, arts, music, dances, stories, tales, etc.) plays a role in the cultural extermination of a population, the recognition of cultural heritage rebuilds the lost social bonds. It helps rescue cultural roots and negates mental disorders as exclusively medical issues. Cultural competencies, a set of professional's attitudes that acknowledge the patients' cultural background in health care, incorporate the ability to significantly and efficiently engage patients' cultural background, values, and beliefs (Kirmayer, 2012 Ortega and Wenceslau, 2020;). This issue is particularly significant in populations that suffered intense persecution in Brazil, like indigenous and "quilombola" (communities created by the descendants of runaway slaves) populations. Scarce literature on the mental health of these populations is available, illustrating the lack of interest in studying this topic thoroughly.

5.1. Indigenous population

The Brazilian indigenous community is currently assisted by multidisciplinary teams from 34 Health Districts. These districts, which interact directly with the indigenous leaders, are meant to mediate the interaction between each indigenous territory and public health services, including the RAPS, guaranteeing practices that respect indigenous traditional health values. The decentralization of indigenous health care was supposed to allow for the plurality of ethnic and cultural diversity of these populations. Also, it was meant to promote their participation in planning and evaluating services. Local health teams are considered strategic as they facilitate the cooperation between the official health system (including RAPS) and traditional knowledge and customs (Altini et al., 2013 Diehl et al., 2012;). These strategies are not yet fully implemented, and in practice, the indigenous participation has so far been mostly neglected (Altini et al., 2013).

Indigenous mental suffering requires a distinct understanding of mental disorders. Health, for the indigenous people, is the result of a collective construction related to the land and harmony with nature. It is built on the idea of a unique organizational system that includes body and environment, and which has key elements including autonomy, land ownership, exclusive use of natural resources and the integrity of specific ecosystems (Altini et al., 2013).

The displacement of indigenous populations represents a real risk to their mental health due to the disruption of their value system and practices arising from their cultural references. In addition, there is still a significant predominance of the use of therapeutic solutions based on the biomedical models, neglecting traditional indigenous healing practices, such as rituals, prayers, baths, teas and beverages (Altini et al., 2013 Barbosa et al., 2019;). One of the current concerns has been the increase in the chronic consumption among indigenous populations of psychotropic drugs due to socioeconomic vulnerability and cultural rupture (Barbosa et al., 2019). A quantitative study in the Northeast region (state of Pernambuco), with the indigenous population of Xukuru de Cumbres ($n = 949$), revealed that 8% of this population is chronically medicated with psychotropics, mostly benzodiazepines (78.67%). Notably, most of those medicated with benzodiazepines were females (73%) (Barbosa et al., 2019). They were medicated by the communitarian primary care services that neglected the collective grief after an internal rupture of this community, with a substantial part of the group now living in even poorer conditions inside urban areas (Barbosa et al., 2019).

5.2. The "Quilombolas"

The "quilombolas" are an Afro-Brazilian social group descended from slaves who live in rural areas around the country, where the "quilombos", refuges for runaway slaves, used to exist. These groups survive mainly on the cultivation of beans, corn and cassava, and are

important cultural markers of black ancestry (de Miranda et al., 2021). Although the Brazilian government has recognized the rights of quilombolas and has given them ownership of their land since 1988, quilombos have little infrastructure and access to services. Racial discrimination, low household income, unemployment, precarious housing conditions and difficult access to education and health persist (dos Santos and Silva, 2014 Kochergin et al., 2014; Silva, 2007;), giving them great psychosocial vulnerability and high prevalence of alcoholism and depression, together with an increased consumption of antidepressants and benzodiazepines (Barroso et al., 2015 de Miranda et al., 2021;).

The quilombola population is growing within their limited area without the possibility of territorial expansion due to the private properties and rural settlements that surround them. This promotes acculturation and brings environmental conflicts, such as deterioration of water resources, soil contamination by pesticides, deforestation and land concentration (Duarte, 2012). The precariousness of available work is identified as one of the main causes of mental and psychosomatic illness in the quilombola population (de Miranda et al., 2021).

Neglecting cultural heritage can be a risk factor for mental disorders, as observed in a quantitative study from quilombola population ($n = 764$ participants) in the Northeast region of Brazil (state of Bahia) (Barroso et al., 2015). The study revealed different risk factors for depression in males and females. Exclusively among women, race self-declaration of not being black was a significant risk factor for depression, along with smoking habits, having another mental health diagnosis, or considering themselves as not having good health. Among men, this last factor was also associated with depression, as was having a chronic disease diagnosis and scarce access to health services (Barroso et al., 2015). The interpretation of these results is not a simple task and it would be necessary to understand the women's reasons not to declare themselves as black. In addition, there seems to be an additive effect of gender and mental health risk factors. The co-occurrence of social risk factors can potentially amplify the vulnerabilities, as was characterized in another study from quilombola population in the Southeast (state of Minas Gerais). It shows the intersection of social factors such as race/ethnicity, gender, region, socioeconomic status, and educational level leading to sub-employment (de Miranda et al., 2021), demonstrating the constant cycle of poverty and mental suffering over generations.

Understanding the local culture helps health professionals plan more efficient strategies to manage care and treatments. For example, in poor sanitary conditions such as those found in Northeast Brazil, primary care services would expect to face widespread infectious diseases that impact children's development. Surprisingly, in a quilombo called "Caiana dos Crioulos" in the state of Paraíba, Northeast, in a population of 522 habitants without clean water or sewer, there was no increase in infectious diseases, nor in diarrhea or pediatric complications (Silva, 2007). A possible explanation is the dissemination of hygiene information and local solutions according to traditional practices, mostly by women healers, and based on phytotherapeutic knowledge (Silva, 2007). However, there were still health issues associated with hypertension, alcohol misuse, and other mental health problems (Silva, 2007).

6. Overcoming prejudice using unbiased technology

As previously noted, Brazilian diversity and expanse are a challenge for the public health system. It is crucial to ensure access to mental illness diagnosis and care even at the most remote sites. Low-cost technological solutions, such as natural language processing tools and digital phenotyping, which can help diagnose psychosis, could mitigate the economic burden and allow mental health evaluations in isolated populations (Argolo et al., 2020 Mota et al., 2016;). These tools can ensure service for those in imminent danger, such as those at clinical high risk of psychosis.

Some techniques use linguistic models based on word co-occurrence frequency from a representative corpus, and can detect psychosis

efficiently, even in prodromal phases (Bedi et al., 2015 Corcoran and Cecchi, 2020; Elvevåg et al., 2007;). Another efficient method, developed in Brazil (Mota et al., 2016, 2014, 2012) and already tested at RAPS services (Mota et al., 2017), is a graph-theoretical based strategy that represents memory reports as word-graphs (Mota et al., 2014, 2012). This method detected cognitive decline linked to psychosis (Mota et al., 2017, 2014 Palaniyappan et al., 2019;) and dementia (Bertola et al., 2014 Malcorra et al., 2021;).

Oral or written reports can be obtained using easily available experimental strategies. Oral reports require only a voice recorder, and allow a precise screening and early identification of severe cases. This is facilitated because in Brazil 82.7% of the adult population has access to internet, and of these, 98.6% use smartphones to access internet (IBGE, 2020).

Helpful information is present not only in words but also in the voice sound. Pitch, pauses, and amplitude of speech waveforms can be measured in recordings made by regular voice recorders like those included in smartphones (Karam et al., 2014). When applied in conjunction with machine learning algorithms, these methods have been shown to detect mental suffering related to mood disorder (Karam et al., 2014 Low et al., 2020;), suicidal ideation (Belouali et al., 2021), dementia (Pulido et al., 2020), anxiety disorders (Low et al., 2020), and psychosis (Low et al., 2020 Stanislawski et al., 2021;).

Screening tools, associated with additional applications that promote communitarian information about the public health system, containing reliable information about the nearest mental health services, could help increase access and allow early intervention. Also, these methods could generate useful data to help plan public policy action and evidence-based management of public mental health strategies based on social determinants. Patients could rely on a more accurate and timely access to treatment, which could lead to less hospitalizations. In addition, these methods could be useful to monitor behavior during specialized and long-lasting treatments.

The computational assessment of behavior is a fast growing field that has powerful potential. However, it needs harmonization in data collection, analytical strategies (Pulido et al., 2020), and a more comprehensive understanding of diagnostic specificity (Cummins et al., 2015 Low et al., 2020;). As the scientific community turns its attention to building common datasets to be used as training sets for computational models (https://discourseinpsychosis.org/), issues of diversity must be considered (Hitzenko et al., 2021). To represent normative or pathological behavior, it is necessary to ensure that the datasets consider the large variety of human behavior expressed in different cultural contexts, to understand how these behavioral markers typically develop, and how they vary according to biological and environmental conditions (Mota, 2021). Also, it is important to know how they match psychopathological concepts, and conceive models that replicate as close as possible human behavior at the present time, keeping in mind the need for constant revisions as cultural changes impact human behavior. Human behavior, such as language, is a basis for social cognition, and has an essential social drive implemented by biological mechanisms (Palaniyappan, 2021). Before accepting a behavioral marker as pathological, it is necessary to understand the typical variability of the specific behavior to avoid calling social, cultural, or environmental determinants behind some behavioral features pathological (Hitzenko et al., 2021). The boundaries between what could be considered pathological or typical behavior call for a broad and diverse representation of data that considers biological diversity and all the complex interactions with environmental diversities.

7. Conclusions

Structural prejudice can impact our judgment of human behavior. Our judgement can be erroneously influenced by factors such as gender, ethnicity, social class and education levels. Especially in large countries like Brazil, there is a need to discuss structural prejudice and its impacts

on mental health assessments and how environmental conditions could disproportionately impact specific populations more than others (Anglin et al., 2021 Czepielewski et al., 2021;). Considering that social disadvantages can be cumulative, we cannot neglect the power of unconscious bias injected on current general databases that mirror actual social prejudices (McFarlane and Illes, 2020). As technology changes social interactions and human behaviors, understanding diversity will be a constant challenge and we will need to be cautious when using technology to judge human behavior (Haraway, 1991). Historically, a cruel endpoint of biased judgement was to call diverse behavior pathological, and use that as a reason for excluding individuals from society (Arbex, 2013). The movement of inclusion and acceptance of behavioral diversity represented by the mental health network in Brazil breaks this cycle. It allows a conscious revision of our concepts of what should be considered as normative or pathological, and in what context.

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References

Altini, E., Rodrigues, G., Padilha, L., Moraes, P.D., Liebgott, R.A., 2013. A Política de Atenção à Saúde Indígena no Brasil. Breve recuperação histórica sobre a política de assistência à saúde nas comunidades indígenas.

Amaral, C.E., Onocko-Campos, R., de Oliveira, P.R.S., Pereira, M.B., Ricci, É.C., Pequeno, M.L., Emerich, B., dos Santos, R.C., Thornicroft, G., 2018. Systematic review of pathways to mental health care in Brazil: narrative synthesis of quantitative and qualitative studies. Int. J. Ment. Health Syst. https://doi.org/10.1186/s13033-018-0237-8.

Amarante, P., Torre, E.H.G., 2018. Back to the city, Mr. Citizen!" — psychiatric reform and social participation: from institutional isolation to the anti-asylum movement. Revista de Administracao Publica 52, 1090–1107 https://doi.org/10.1590/0034-761220170130.

Amarante, P., Torre, E.H.G., 2017. Loucura e diversidade cultural: inovação e ruptura nas experiências de arte e cultura da Reforma Psiquiátrica e do campo da Saúde Mental no Brasil. Interface 21, 763–774 https://doi.org/10.1590/1807-57622016.0881.

Anglin, D.M., Ereshefsky, S., Klaunig, M.J., Bridgwater, M.A., Niendam, T.A., Ellman, L. M., DeVylder, J., Thayer, G., Bolden, K., Musket, C.W., Grattan, R.E., Lincoln, S.H., Schiffman, J., Lipner, E., Bachman, P., Corcoran, C.M., Mota, N.B., van der Ven, E., 2021. From Womb to Neighborhood: a Racial Analysis of Social Determinants of Psychosis in the United States. Am. J. Psychiatry 178, 599–610 https://doi.org/10.1176/appi.ajp.2020.20071091.

Arbex, D., 2013. Holocausto Brasileiro, vida, genocídio e 60 mil mortes no maior hospício do Brasil. Geração Editorial, 1st ed. São Paulo.

Argolo, F., Magnavita, G., Mota, N.B., Ziebold, C., 2020. Lowering costs for large-scale screening in psychosis: a systematic review and meta-analysis of performance and value of information for speech-based psychiatric evaluation. Braz. J. Psychiatry 42, 673–686 https://doi.org/10.1590/1516.

Barbosa, V.F.B., Cabral, L.B., Alexandre, A.C.S., 2019. Medicalization and indigenous health: an analysis of the consumption of psychotropics by the xukuru de cimbres indigenous people. Ciencia e Saude Coletiva 24, 2993–3000 https://doi.org/10.1590/1413-81232018248.22192017.

Barroso, S.M., Melo, A.P., Guimarães, M.D.C., 2015. Fatores associados à depressão: diferenças por sexo em moradores de comunidades quilombolas. Revista Brasileira de Epidemiologia 18, 503–514 https://doi.org/10.1590/1980-5497201500020017.

Bedi, G., Carrillo, F., Cecchi, G.A., Slezak, D.F., Sigman, M., Mota, N.B., Ribeiro, S., Javitt, D.C., Copelli, M., Corcoran, C.M., 2015. Automated analysis of free speech predicts psychosis onset in high-risk youths. NPJ Schizophr. 1 https://doi.org/10.1038/npjschz.2015.30.

Belouali, A., Gupta, S., Sourirajan, V., Yu, J., Allen, N., Alaoui, A., Dutton, M.A., Reinhard, M.J., 2021. Acoustic and language analysis of speech for suicidal ideation among US veterans. BioData Min. 14 https://doi.org/10.1186/s13040-021-00245-y.

Bertola, L., Mota, N.B., Copelli, M., Rivero, T., Diniz, B.S., Ribeiro, M.A.R., Ribeiro, S., Malloy-Diniz, L.F., 2014. Graph analysis of verbal fluency test discriminate between patients with Alzheimer's disease, Mild Cognitive Impairment and normal elderly controls. Front. Aging Neurosci. 6 https://doi.org/10.3389/fnagi.2014.00185.

Carvalho-Silva, D.R., Santos, F.R., Rocha, J., Pena, S.D.J., 2001. The phylogeography of Brazilian Y-chromosome lineages. Am. J. Hum. Genet.

Centifanti, L.C., Williams, D.M., 2017. The Wiley Handbook of Developmental Psychopathology. The Wiley Handbook of Developmental Psychopathology. Wiley & Sons.

Corcoran, C.M., Cecchi, G.A., 2020. Using language processing and speech analysis for the identification of psychosis and other disorders. Biolog. Psychiatry https://doi.org/10.1016/j.bpsc.2020.06.004.

Costa, N.do R., Corrêa, S.G.de P., da Silva, P.R.F., 2015. Considerações sobre a acessibilidade nos Centros de Atenção Psicossocial no Brasil. Ciencia e Saude Coletiva 20, 3139–3150 https://doi.org/10.1590/1413-812320152010.19482014.

Cummins, N., Scherer, S., Krajewski, J., Schnieder, S., Epps, J., Quatieri, T.F., 2015. A review of depression and suicide risk assessment using speech analysis. Speech Commun. https://doi.org/10.1016/j.specom.2015.03.004.

Czepielewski, L.S., Alliende, L.M., Castañeda, C.P., Castro, M., Guinjoan, S.M., Massuda, R., Berberian, A.A., Fonseca, A.O., Gadelha, A., Bressan, R., Crivelaro, M., Louzã, M., Undurraga, J., González-Valderrama, A., Nachar, R., Nieto, R.R., Montes, C., Silva, H., Langer, Á.I., Schmidt, C., Mayol-Troncoso, R., Díaz-Zuluaga, A. M., Valencia-Echeverry, J., López-Jaramillo, C., Solís-Vivanco, R., Reyes-Madrigal, F., de La Fuente-Sandoval, C., Crossley, N.A., Gama, C.S., 2021. Effects of socioeconomic status in cognition of people with schizophrenia: results from a Latin American collaboration network with 1175 subjects. Psychol. Med. https://doi.org/10.1017/S0033291721002403.

de Miranda, S.V.C., de Oliveira, J.L., Sampaio, C.A., Neto, J.F.R., 2021. Mapping the working conditions of quilombola men and intersections between informality and mental health. Interface 25 https://doi.org/10.1590/INTERFACE.200478.

Diehl, E.E., Langdon, E.J., Dias-Scopel, R.P., 2012. Contribuição dos agentes indígenas de saúde na atenção diferenciada à saúde dos povos indígenas brasileiros; The contribution of indigenous community health workers to special healthcare for Brazilian indigenous peoples. Cad. Saúde Pública 28, 819–831.

dos Santos, R.C., Bosi, M.L.M., 2021. Mental health in primary care: perspectives of professionals of the family health strategy in northeastern brazil. Ciencia e Saude Coletiva 26, 1739–1748 https://doi.org/10.1590/1413-81232021265.04902021.

dos Santos, R.C., Silva, M.S., 2014. Condições de vida e itinerários terapêuticos de quilombolas de Goiás. Saude e Sociedade 23, 1049–1063 https://doi.org/10.1590/S0104-12902014000300025.

Duarte, F.C., 2012. A EXPANSÃO DA MONOCULTURA DE EUCALIPTO NO NOROESTE FLUMINENSE E SEU POTENCIAL PARA A GERAÇÃO DE CONFLITOS SOCIOAMBIENTAIS. Rio de Janeiro.

Elevåg, B., Foltz, P.W., Weinberger, D.R., Goldberg, T.E., 2007. Quantifying incoherence in speech: an automated methodology and novel application to schizophrenia. Schizophr. Res. 93, 304–316 https://doi.org/10.1016/j.schres.2007.03.001.

Fernandes, C.S.E., Lima, M.G., Barros, M.B.de A., 2020. Emotional problems and the use of psychotropic drugs: investigating racial inequality. Ciencia e Saude Coletiva 25, 1677–1688 https://doi.org/10.1590/1413-81232020255.33362019.

Gabriel, P., Delgado, G., 2020. Italian Home Contacts Credits Mental health reform in Brazil: changing hospital-centered paradigm to ensure access to care. Centro Studi sulla Sofferenza Urbana.

Haraway, D., 1991. Simians, Cyborg, and Women. The Reinvention of Nature. Routledge.

Hitczenko, K., Cowan, H.R., Goldrick, M., Mittal, V.A., 2021. Racial and Ethnic Biases in Computational Approaches to Psychopathology. Schizophr. Bull. https://doi.org/10.1093/schbul/sbab131.

IBGE, 2020. PNAD contínua: Pesquisa Nacional Por Amostra de Domicílios Contínua 2018/2019. Instituto Brasileiro de Geografia e Estatística.

IBGE, 2007. Brasil: 500 Anos De Povoamento, 1st ed. Rio de Janeiro.

Karam, Z.N., Provost, E.M., Singh, S., Montgomery, J., Archer, C., Harrington, G., Mcinnis, M.G., 2014. Ecologically valid long-term mood monitoring of individuals with bipolar disorder using speech. In: Proc IEEE Int Conf Acoust Speech Signal Process, pp. 4858–4862 https://doi.org/10.1109/ICASSP.

Kirmayer, L.J., 2012. Rethinking cultural competence. Transcult. Psychiatry https://doi.org/10.1177/1363461512444673.

Kochergin, C.N., Proietti, F.A., César, C.C., 2014. Comunidades quilombolas de vitória da conquista. In: Autoavaliação De Saúde E Fatores Associados, 30. Cadernos de Saude Publica, Bahia, Brasil, pp. 1487–1501 https://doi.org/10.1590/0102-311×00141213.

Krachenski, N.B., Furtado Holanda, A., 2019. Artigos manejo de crise nos centros de atenção psicossocial: uma revisão sistemática de literatura crisis management in

psychosocial care centers: a systematic literature review. Pluralidades em Saúde Mental.

Leão, O., Neto, E.C., Barreto, S., De, R., Ribeiro, C., Lins Keusen, A., Cavalcanti, M.T., 2021. O PAPEL DO SUPORTE DE PARES NO PROCESSO DE RECOVERY: A EXPERIÊNCIA DO PROGRAMA ENTRELAÇOS.

Levy, M.S.F., 1974. O papel da migração internacional na evolução da população Brasileira (1872 A 1972). Rev Saúde Públ 8, 49–90.

Lima Bezerra, M., Magda, S.I., Bezerra, D., Ii, D., 2014. Manejo da crise: encaminhamento e internação psiquiátrica em questão. Arq Bras Psicol.

Low, D.M., Bentley, K.H., Ghosh, S.S., 2020. Automated assessment of psychiatric disorders using speech: a systematic review. Laryngosc. Investigat. Otolaryngol. 5, 96–116 https://doi.org/10.1002/lio2.354.

Lund, C., Brooke-Sumner, C., Baingana, F., Baron, E.C., Breuer, E., Chandra, P., Haushofer, J., Herrman, H., Jordans, M., Kieling, C., Medina-Mora, M.E., Morgan, E., Omigbodun, O., Tol, W., Patel, V., Saxena, S., 2018. Social determinants of mental disorders and the Sustainable Development Goals: a systematic review of reviews. Lancet Psychiatry https://doi.org/10.1016/S2215-0366(18)30060-9.

Luzio, C.A., L'Abbate, S., 2009. A atenção em Saúde Mental em municípiosde pequeno e médio portes: ressonâncias da reforma psiquiátrica. Ciência & Saúde Coletiva 14, 105–116.

Malcorra, B.L.C., Mota, N.B., Weissheimer, J., Schilling, L.P., Wilson, M.A., Hübner, L.C., 2021. Low speech connectedness in alzheimer's disease is associated with poorer semantic memory performance. J. Alzheimer's Dis. 82, 905–912 https://doi.org/10.3233/JAD-210134.

McFarlane, J., Illes, J., 2020. Neuroethics at the interface of machine learning and schizophrenia. NPJ Schizophr. https://doi.org/10.1038/s41537-020-0108-6.

Mota, N.B., 2021. Commentary on "Investigating the diagnostic utility of speech patterns in schizophrenia and their symptom associations": the current need for the harmonization of speech elicitation protocols in basic and applied science. Schizophr. Res. 238, 199–200 https://doi.org/10.1016/j.schres.2021.11.013.

Mota, N.B., Copelli, M., Ribeiro, S., 2017. Thought disorder measured as random speech structure classifies negative symptoms and schizophrenia diagnosis 6 months in advance. NPJ Schizophr. 3 https://doi.org/10.1038/s41537-017-0019-3.

Mota, N.B., Copelli, M., Ribeiro, S., 2016. Computational tracking of mental health in youth: Latin American contributions to a low-cost and effective solution for early psychiatric diagnosis. New Dir. Child Adolesc. Dev. https://doi.org/10.1002/cad.20159.

Mota, N.B., Furtado, R., Maia, P.P.C., Copelli, M., Ribeiro, S., 2014. Graph analysis of dream reports is especially informative about psychosis. Sci. Rep. 4 https://doi.org/10.1038/srep03691.

Mota, N.B., Vasconcelos, N.A.P., Lemos, N., Pieretti, A.C., Kinouchi, O., Cecchi, G.A., Copelli, M., Ribeiro, S., 2012. Speech graphs provide a quantitative measure of thought disorder in psychosis. PLoS One 7 https://doi.org/10.1371/journal.pone.0034928.

Ortega, F., Wenceslau, L.D., 2020. Challenges for implementing a global mental health agenda in Brazil: the "silencing" of culture. Transcult. Psychiatry 57, 57–70 https://doi.org/10.1177/1363461518824433.

Palaniyappan, L., 2021. More than a biomarker: could language be a biosocial marker of psychosis? NPJ Schizophr. 7, 42https://doi.org/10.1038/s41537-021-00172-1.

Palaniyappan, L., Mota, N.B., Oowise, S., Balain, V., Copelli, M., Ribeiro, S., Liddle, P.F., 2019. Speech structure links the neural and socio-behavioural correlates of psychotic disorders. Prog. Neuropsychopharmacol. Biol. Psychiatry 88 https://doi.org/10.1016/j.pnpbp.2018.07.007.

Pavão, A.L.B., Ploubidis, G.B., Werneck, G., Campos, M.R., 2012. Racial discrimination and health in Brazil: evidence from a population-based survey. Ethn. Dis. 22, 353–359.

Pitta, A.M.F., Coutinho, D.M., Rocha, C.C.M., 2015. Direitos humanos nos Centros de Atenção Psicossocial do Nordeste do Brasil: um estudo avaliativo, tendo como referência o QualityRights - WHO. Saúde em Debate 39, 760–771 https://doi.org/10.1590/0103-1104201510600030016.

Portugal, C.M., Mezza, M., Nunes, M., 2018. The clinic between brackets: reflections on the role of art and militancy in the lives of mental health users. Physis 28 https://doi.org/10.1590/S0103-73312018280211.

Pulido, M.L.B., Hernández, J.B.A., Ballester, M.Á.F., González, C.M.T., Mekyska, J., Smékal, Z., 2020. Alzheimer's disease and automatic speech analysis: a review. Exp. Syst. Appl. https://doi.org/10.1016/j.eswa.2020.113213.

Rosa, L.C.S., Campos, R.T.O., 2013. Saúde mental e classe social: CAPS, um serviço de classe e interclasse; Mental Health and social class: CAPS (Psychosicial Care Centers), a service that is oriented to a social class. Serv Soc. Soc 114, 311–331.

Salles, M.M., Barros, S., 2013a. Representações sociais de usuários de um Centro de Atenção Psicossocial e pessoas de sua rede sobre doença mental e inclusão social. Saúde Soc 22, 1059–1071.

Salles, M.M., Barros, S., 2013b. EXCLUSÃO/INCLUSÃO SOCIAL DE USUÁRIOS DE UM CENTRO DE ATENÇÃO PSICOSSOCIAL NA VIDA COTIDIANA 1, Jul-Set.

Santos, M., 2002. A Natureza do Espaço. São Paulo.

Santos, V.A., Martins, T.H., 2016. Um breve percurso na prática de inserção social em um centro de atenção psicossocial – CAPS na Bahia. Rev. Polis e Psique 6, 124–144.

Silva, J.A.N., 2007. Condições sanitárias e de saúde em caiana dos crioulos, uma comunidade quilombola do estado da paraíba; sanitary and health conditions at caiana dos crioulos, a quilombo community in the State of Paraíba. Saúde Soc 16, 111–124.

Soifer, S.D., McNeely, J.B., Costa, C.L.; Pickering-Bernheim, N., 2014. Community Economic Development in Social Work. Community Economic Development in Social Work. Columbia University Press.

Sousa, F.S.P.de, Jorge, M.S.B., 2018. O retorno da centralidade do hospital psiquiátrico: retrocessos recentes na política de saúde mental. Trabalho, Educação e Saúde 17 https://doi.org/10.1590/1981-7746-sol00172.

Stanislawski, E.R., Bilgrami, Z.R., Sarac, C., Garg, S., Heisig, S., Cecchi, G.A., Agurto, C., Corcoran, C.M., 2021. Negative symptoms and speech pauses in youths at clinical high risk for psychosis. NPJ Schizophr. 7 https://doi.org/10.1038/s41537-020-00132-1.

Tavares, M., Liberato, C., Dimenstein, M., 2013. Art, madness, and city: the invention of new possible. Psicologia & Sociedade 25 (2), 272–281.

Thiesen, J., Fortes, S., Cavalcanti, M.T., 2021. The impact of territorial care in the treatment of people diagnosed with schizophrenia and delusional disorders in a Rio de Janeiro community. Salud Colect. 17, 1–17 https://doi.org/10.18294/SC.2021.3020.

Tostes, J.G.de A., Bandeira, M., Oliveira, M.S.de, 2020. Predictors of neighbors' attitudes toward persons with mental illness and therapeutic residential services in Brazil. Stigma Health 5, 138–145 https://doi.org/10.1037/sah0000178.

World Health Organization, 2021. Guidance On Community Mental Health Services Promoting person-Centred and Rights-Based Approaches. Geneva.

World Health Organization., 2008. Policies and practices for mental health in Europe. WHO.