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Are Providers More Likely to Contribute to Healthcare Disparities Under High Levels of Cognitive Load? How Features of the Healthcare Setting May Lead to Biases in Medical Decision Making

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Abstract

Systematic reviews of healthcare disparities suggest that clinicians' diagnostic and therapeutic decision making varies by clinically irrelevant characteristics, such as patient race, and that this variation may contribute to healthcare disparities. However, there is little understanding of the particular features of the healthcare setting under which clinicians are most likely to be inappropriately influenced by these characteristics. This study delineates several hypotheses to stimulate future research in this area. It is posited that healthcare settings in which providers experience high levels of cognitive load will increase the likelihood of racial disparities via 2 pathways. First, providers who experience higher levels of cognitive load are hypothesized to make poorer medical decisions and provide poorer care for all patients, due to lower levels of controlled processing (H1). Second, under greater levels of cognitive load, it is hypothesized that healthcare providers' medical decisions and interpersonal behaviors will be more likely to be influenced by racial stereotypes, leading to poorer processes and outcomes of care for racial minority patients (H2). It is further hypothesized that certain characteristics of healthcare settings will result in higher levels of cognitive load experienced by providers (H3). Finally, it is hypothesized that minority patients will be disproportionately likely to be treated in healthcare settings in which providers experience greater levels of cognitive load (H4a), which will result in racial disparities due to lower levels of controlled processing by providers (H4b) and the influence of racial stereotypes (H4c). The study concludes with implications for research and practice that flow from this framework.

Keywords

healthcare disparities; stereotyping; organizations; race/ethnicity; social cognition; cognitive load

This study introduces a conceptual framework for exploring how features of healthcare settings that increase cognitive load may contribute to racial/ethnic disparities in healthcare. In this study, cognitive load can be thought of as the amount of mental activity imposed on

working memory, which may come from competing mental tasks, environmental factors, our own psychological or physiological state (e.g., fatigue), as well as from the demands inherent in the task at hand (i.e., intrinsic cognitive load). According to this formulation, cognitive load is best conceptualized as a quantity that varies rather than a state that is either present or absent.

The conceptual framework presented below is grounded in dual process models of social cognition, in which controlled and automatic processes handle different types of mental activities.^{1,2} Controlled processes involve intentional, conscious, and effortful thought. Importantly, high levels of cognitive load can interrupt, impair, or prevent the successful execution of controlled processes by “taking up” the necessary cognitive resources for those processes. By contrast, automatic processes are relatively effortless, can occur outside of consciousness and without intent, and importantly, are not disrupted under high levels of cognitive load. Recent studies have identified a neurocognitive basis for this distinction, identifying different patterns of neural activation for automatic versus controlled processes.³

PRIMARY HYPOTHESES

It is posited that healthcare settings in which providers experience high levels of cognitive load will increase the likelihood of racial disparities via 2 pathways. First, providers who experience higher levels of cognitive load are hypothesized to make poorer medical decisions and provide poorer care for all patients, due to lower levels of controlled processing (H1). Second, under greater levels of cognitive load, it is hypothesized that healthcare providers’ medical decisions and interpersonal behaviors will be more likely to be influenced by racial stereotypes, leading to poorer processes and outcomes of care for racial minority patients (H2). It is further hypothesized that certain healthcare settings will result in higher levels of cognitive load experienced by providers (H3). Finally, it is hypothesized that minority patients will be disproportionately likely to be treated in healthcare settings in which providers experience greater levels of cognitive load (H4a), which will result in racial disparities due to lower levels of controlled processing by providers (H4b) and the influence of racial stereotypes (H4c).

Hypothesis 1: Providers Who Experience Higher Levels of Cognitive Load Will Make Poorer Medical Decisions and Provide Poorer Care for all Patients, due to Lower Levels of Controlled Processing

To understand the impact of cognitive load on medical decisions and patient care, it is important to understand the role of automatic and controlled processes in learning and performance. In learning a new task, we expend precious cognitive resources engaging in controlled processes. When we are learning how to drive, for example, we spend a great deal of conscious effort thinking about negotiating the brakes, clutch, gas pedal and paying attention to steering—tasks that constitute intrinsic cognitive load—and consequently have very little attention to spare for other tasks. After we have learned and practiced the behavior it becomes automatized and we have spare cognitive resources to devote to other tasks. However, even after we have become experts, there can be external circumstances where we need to pay attention, snap out of our automatic behavior, and shift our attention to the situation at hand. Usually, we are adept at conserving cognitive resources by strategically

reallocating those resources to where they are most needed. However, our ability to reallocate attention is hindered under high levels of cognitive load (e.g., fatigue, poor road conditions) and we are not as efficient at shifting from automatic to controlled processing.^{4,5}

As scholars and practitioners are well aware, the art of medicine involves numerous mental processes, many of which become automatized with training. For example, experienced clinicians tend to generate diagnoses automatically when faced with patients whose pattern of symptoms “matches” previously seen patterns of symptom configurations.⁶ Clinicians also rely on a number of medical heuristics or “shortcuts” that facilitate decision making.⁷ In the ideal scenario, clinicians are able to strategically shift from automatic to controlled processes when the situation is warranted, such as when faced with complex or unfamiliar cases, or in instances when it is important to critically reflect upon their decisions.⁸ However, under cognitive load, clinicians’ ability to switch from controlled to automatic processes is expected to become compromised, leading to poorer care.

The detrimental effect of various sources of cognitive load, such as fatigue, stress, mental distress, excessive workload, inadequate staffing, and time pressure on medical errors and impaired cognitive performance by clinicians is well documented (see hypothesis 3 for a more comprehensive discussion).^{9–15} However, there is a dearth of studies that have rigorously examined the effect of cognitive load on providers using methods from other disciplines, such as aviation, and human factors and educational research.^{16–18}

Hypothesis 2: Under Greater Levels of Cognitive Load, Providers’ Medical Decisions and Interpersonal Behaviors Are More Likely to Be Influenced by Racial Stereotypes, Leading to Poorer Processes and Outcomes of Care for Racial Minority Patients

The processes by which provider stereotyping is posited to contribute to racial disparities in care have received significant attention in the recent Institute of Medicine (IOM) report.¹⁹ Salient patient characteristics, such as race, gender, and age, may activate stereotypes that might lead to biases in providers’ interpretation of behaviors and symptoms, expectations about patient behaviors (e.g., adherence), and medical decisions, and may also adversely influence the quality of the medical encounter.^{20–23}

Several lines of research support the hypothesis that medical decision making will be more likely to be influenced by racial/ethnic stereotypes under high levels of cognitive load.

Numerous studies have shown that activation and application of stereotypes can be automatic processes that occur unconsciously and unintentionally—a phenomenon known as implicit stereotyping.^{20,22} Indeed, there is evidence that white physicians hold negative implicit (unconscious) stereotypes about African Americans (as do whites in the general population), which can result in medical decision-making biases.²⁴ However, it is possible to override or correct for these automatic processes of categorization and stereotyping, via controlled processes, if we have sufficient cognitive resources and we are motivated to do so.^{25,26} With sufficient cognitive resources and motivation, it is more likely that we will engage in individuation—an effortful, controlled process in which we focus on the unique features of the person with whom we are interacting, which may differ from the stereotype that was automatically activated.²⁷ If we are aware that we may engage in bias due to

stereotypes and we are motivated to overcome this, we also may engage in “de-biasing” or “correction” strategies where we actively try to correct for judgments that we suspect may be “tainted” by stereotypes.²⁸ Conversely, under greater levels of cognitive load, individuation and correction for activated stereotypes are less likely.

One line of research supporting H2 uses an experimental paradigm in which subjects are randomly assigned to evaluate or make judgments about “targets” from different social categories (e.g., male v. female; black v. white) under conditions of high v. low levels of cognitive load. Cognitive load is typically manipulated by having subjects perform a concurrent mental task, such as rehearsing an 8-digit string of numbers^{29,30} or attending to a news broadcast.³¹ Cognitive load manipulation has also involved increasing the complexity of the judgment task,³² putting subjects under time pressure,³³ and having subjects perform tasks during their “off peak” phase of circadian arousal (during the daytime for “night owls” and during the nighttime for “morning people”).³⁴ These studies have consistently found that biased decisions (e.g., gender bias in performance ratings, age discrimination in hiring decisions) are more likely for subjects who are making the decisions under high levels of cognitive load.^{30,35–41}

Converging evidence for H2 comes from neuroimaging studies demonstrating that the desire and ability to regulate attitudes, in general, and prejudiced attitudes, in particular, is associated with greater activity of the right lateral prefrontal cortex (LPFC), an area of the brain that supports controlled processing.^{3,42,43} Likewise, activation of the LPFC is associated with inhibition of biased beliefs within the context of solving logic problems⁴⁴—a process analogous to what providers would engage in if they were to correct for the influence of automatically activated stereotypes. There is also evidence that the process of self-reflection on emotional stimuli—a controlled process whose activity is disrupted by cognitive load manipulations—can reduce activity in the amygdala⁴⁵—part of the automatic processing system that is associated with implicit prejudice.⁴²

An important issue is why cognitive load might increase the use of clinically irrelevant characteristics such as race as opposed to clinically relevant characteristics that activate the appropriate scripts for diagnostic reasoning.⁶ One explanation is that certain patient characteristics such as African American race are more likely than other characteristics to automatically activate stereotypes.⁴⁶ Specifically, neuroimaging studies have shown differential activity in the amygdala, the area of the brain that is responsive to perceived threat, in response to African American compared with white men.⁴² Evolutionary psychologists have posited that our brains are wired to be highly responsive to characteristics associated with survival (i.e., those associated with physical threat) and reproductive fitness (e.g., age, gender), suggesting that certain patient characteristics may predominate even when they are not clinically relevant.^{46,47} Cognitive load may also increase the extent that automatically activated, clinically irrelevant stereotypes are applied, by inhibiting their suppression, an explanation consistent with a study in which higher levels of cognitive load predicted poorer ability to control inhibit stereotypic responses on a stereotype inhibition task.⁴⁸

The single published study explicitly designed to test the hypothesis that cognitive load increases provider contribution to disparities due to stereotyping operationalized cognitive load in terms of low versus high patient load.⁴⁹ This study employed a retrospective chart review based on the records of 1236 adult psychiatric patients treated in psychiatric emergency services. The patient load variable was derived by combining the average number of patients typically seen during specified shifts (“institutional peak times”) and the actual volume of patients seen by the individual clinician during his or her shift (“stratified individual peak times”). Patient records were sampled according to this measure of patient load, in which random samples were taken from all adult patients evaluated by each clinician during low peak and high peak shifts. The researchers found that, under conditions of high cognitive load, being female compared with being male increased the odds of receiving a diagnosis of depressive disorder, a disorder that has been shown to be overdiagnosed among women and that has been viewed as a stereotypically female condition.⁵⁰ This provides indirect evidence that provider bias may be greater under higher levels of cognitive load, although it is limited by the fact that stereotyping was not measured, but merely inferred.

Hypothesis 3: Certain Characteristics of Healthcare Settings Will Result in Higher Levels of Cognitive Load Experienced by Providers

Hypothesis 3a: Providers Will Experience Greater Levels of Cognitive Load in Settings in which They Face Greater “Competing Demands”

Health service researchers are well aware of the multiple demands that compete for providers’ attention within clinical encounters, particularly for complex patients with multiple chronic conditions.^{51–56} From a social cognitive perspective, competing demands include not only clinical tasks, but other tasks that require effortful cognitive “work,” such as communicating with patients with low English language proficiency or diminished cognitive capacity. Hence, patient case mix is likely to increase cognitive load to the extent that it is comprised of patient populations that impose a greater number of demands on providers.

Hypothesis 3b: Providers Will Experience Greater Levels of Cognitive Load in Settings in which They Experience Higher Levels of Fatigue, Stress, Anxiety, Distress, and Time Pressure

Numerous studies have shown that fatigue, sleep deprivation, chronic and acute stress, and anxiety significantly deplete working memory and diminish mental processing ability.^{57–74} There also is evidence that physiological and psychological impairments diminish providers’ performance in healthcare settings. For example, studies of physicians, residents, nurses, and paramedics have found that higher levels of acute and chronic stress, fatigue, psychological distress, depression, and burnout are associated with a greater likelihood of making medical errors and providing suboptimal or poorer patient care.^{10,11,13,75–79}

Research has shown a linkage between characteristics of practice settings and physician work stress. For example, physician work stress has been shown to be greater for individuals in solo practice and for physicians treating a greater number of complex patients with multiple clinical conditions.⁸⁰ Greater levels of physician stress have also been associated with low levels of perceived control over workplace and administrative issues, low levels of

perceived organizational support for balancing work and family,^{80,81} and sexual or racial harassment,^{80,82–84} and greater perceived time pressure, overload, and numbers of hours worked.^{79,80,85–87}

Hypothesis 3c: Facilities with High Proportions of Trainees Will Be Particularly Vulnerable to the Adverse Effects of Cognitive Load—

Central to theories of learning is the concept that the initial acquisition of tasks or skills is effortful and hence takes up valuable working memory capacity. With practice, skills become increasingly automatized and impose less cognitive burden on providers. Related to this, experts use less cognitive capacity than novices when solving problems, because their mental representations are more elaborate and able to integrate more knowledge into a single representation or chunk. Hence, the expert is able to allocate more resources to other cognitive activities. For instance, a physician with greater experience in a particular domain will develop a richer schema and so is able to better integrate separate pieces of clinical information into a larger chunk than a physician with less experience, leaving him or her with greater cognitive resources to attend to other mental tasks. Conversely, the less expert physician may be more likely to rely on stereotyping because he or she has less cognitive capacity to integrate individual-level information.

Teaching hospitals that rely on residents are also likely to experience high levels of cognitive load among its workforce, since fatigue, work stress, and emotional exhaustion continue to remain high among residents, even after the enactment (in 2003) of legislation that limited residents' work week to 80 hours and restricted residents to a maximum of 30 hours of continuous duty. While some studies have shown reductions in residents' fatigue, stress, and emotional exhaustion since this legislation was enacted,^{88,89} other studies found no change in total work or sleep hours following enactment of this legislation.⁹⁰

Hypothesis 3d: Providers Will Experience Lower Levels of Cognitive Load in Settings with Greater Structures and Practices that Support Medical-Decision Making—

Structures and practices that support medical decisions may alleviate the cognitive burden associated with particular clinical tasks.^{91–93} However, the design of the technological structures is critical in determining whether the technology will reduce or contribute to cognitive load. This is illustrated by 2 recent studies conducted with medical students and board certified physicians that examined the extent to which presentation of clinical information affects cognitive load.⁹⁴ Cognitive load was found to be lower when patient information was presented via a combination of symbols and texts (i.e., “knowledge-enhanced graphical symbols”) compared with when it was presented via traditional charts and records, underscoring the importance of designing technological systems that minimize provider cognitive load and the need for additional research to inform these design considerations. In addition, although new technologies may ultimately reduce provider cognitive load, during the learning phase new technological systems are likely to contribute to cognitive load until their use becomes automatized.

Indirect evidence for H3d comes from studies in which increases in quality improvement are associated with reductions in racial disparities (in hemodialysis, breast cancer screening, diabetes care processes, cardiovascular care, congestive heart failure, and depression).^{95–98}

Although the mechanisms that underlie these reductions in disparities are unknown, it is plausible that structures and processes designed to improve quality, such as clinical support systems, may reduce the effect of racial stereotypes on decision making by decreasing cognitive load experienced by providers.

Hypothesis 3e: Providers Will Experience Higher Levels of Cognitive Load When Interacting with Patients of a Different Race or Ethnicity—Interactions with someone of another race has been shown to be another source of cognitive load that can impair performance (H1) and promote the use of stereotypes (H2), because these interactions lead to increased anxiety and an increase in self-regulatory behaviors, such as monitoring or regulating one's thoughts, feelings, or behaviors to avoid appearing prejudiced.^{99–104} A drawback to this research is that it consists entirely of laboratory studies with undergraduate students. However, a study showing that physicians experience anxiety when interacting with black or Latino patients, and that self-reported ratings of interracial anxiety are associated with lower patient ratings of encounter quality among nonwhite patients,¹⁰⁵ suggests that examining the effects of interracial anxiety on a broader range of outcomes (e.g., medical decision making) would be a fruitful area for future research.

Hypothesis 4: Minority Patients Are Disproportionately Likely To Be Treated in Healthcare Settings in which Providers Experience Greater Levels of Cognitive Load (H4a) and Are Therefore Expected To Experience Poorer Care than Whites due to Lower Levels of Controlled Processing by Providers (H4b) and the Influence of Racial Stereotypes (H4c)

There is evidence that racial and ethnic minorities are more likely than whites to be treated in settings in which providers experience high levels of cognitive load.¹⁰⁶ For example, physicians in clinics with at least 30% minority patients ($N = 27$) were more likely than physicians in other clinics ($N = 69$) to lack access to referral specialists, to have more difficult patients (e.g., patients who have chronic pain and substance abuse; patients who are medically and psychosocially complex) and to report lower levels of job satisfaction and work control and were 4 times more likely to report a chaotic workplace.¹⁰⁷ Racial minorities are also more likely to be treated in settings that lack technologies, such as computerized record systems, which have the potential to reduce cognitive load. There is also evidence that African Americans are less likely to be treated by physicians with the highest levels of expertise (board certified physicians, “high volume” surgical teams),^{108–111} who require fewer cognitive resources than less experienced providers. International medical graduates, who make up a large percentage of the work force in settings in which minorities receive care, experience a great deal of stress, including perceived discrimination, cultural differences, and a lack of social support.¹⁹

Because the majority of African Americans in the United States currently receive care within a relatively small percentage of hospitals,^{106,108,112,113} it is particularly important to examine whether providers working in those settings experience greater levels of cognitive load compared with providers in predominantly white settings. Although there is evidence that the site of care may contribute to disparities,^{106,108,113–118} with nonwhites more likely to be treated in facilities in which they receive lower quality care than whites, researchers have generally conceptualized patient race and site of care as separate and competing factors

and have not examined how the two may interact,¹⁰⁶ so that it is not possible to determine whether certain settings render provider bias more likely, an “either/or perspective” illustrated by a question posed in one journal article: “Are racial disparities the result of who you are or where you seek care?”¹¹⁹ An exception is 2 recent studies in which racial disparities in treatment were greater in facilities that had larger minority populations.^{120,121} Nonetheless, additional research that examines the interactive as well as the main effects of patient race and racial composition of the healthcare facility is needed.

IMPLICATIONS FOR RESEARCH

Much of the existing research supporting the proposition that provider stereotypes and bias contributes to disparities in healthcare comes from vignette studies in which patient race is experimentally manipulated in the form of a clinical vignette and the provider is asked to make a series of medical decisions. However, many vignette studies fail to find strong main effects of race: either race unexpectedly interacts with another factor or the effect of race is not significant^{122–125}; see Aberegg and Terry¹²⁶ for a discussion. For instance, in contrast to the numerous studies documenting racial disparities in treatment of cardiovascular disease,^{127,128} several factorial experiments found no effect of patient race on physicians’ treatment decisions for coronary heart disease^{129,130,131} and coronary revascularization,¹³² and the well-publicized study by Schulman and others.¹³³ found lower likelihood of cardiac catheterization only for black women, but not for black men. Similarly, despite documented disparities in depression diagnosis and treatment in African Americans, several experiments using videotaped vignettes failed to find an effect of race on diagnosis and treatment.^{134–136}

This lack of simple main effects of race using experimental vignettes for conditions in which there are documented racial disparities in care points to the difficulty and importance of creating vignette experiments that fully capture the complexity of the clinical encounter. Although the experimental method eliminates threats to internal validity inherent in observational studies, allowing researchers to isolate the effect of race from potentially confounding factors (e.g., socioeconomic status, expression of pain), in its current form it creates a condition in which providers have time to rely on more effortful strategies of individuation, thus reducing the impact of unconscious stereotypes.²⁷ It is plausible that this failure to account for providers’ cognitive load in vignette studies may help explain why these studies do not provide consistent and strong support for the hypothesis that stereotyping contributes to disparities in healthcare.

I suggest that researchers who seek to study the provider contribution to disparities incorporate cognitive load into their research design. To fully understand the effect of cognitive load on disparities in processes and outcomes of care it will be necessary to take a multimethodological approach. Efforts should be made to conduct vignette studies (in which race and other patient characteristics are systematically manipulated) with standardized patients, in contexts that contain the types of cognitive demands that providers face in the clinical setting (e.g., fatigue, stress, competing demands). Other experiments might manipulate and measure the effects of cognitive load on providers’ task performance using standardized patients or using other types of simulations. Observational studies might operationalize cognitive load via organizational characteristics posited to be associated with

cognitive load (“distal measures” such as patient volume, presence of international medical graduates; provider work flow) as well as proximal measures of cognitive load (e.g., burnout, stress, perceived overload), to examine the extent to which cognitive load mediates the relationship between organizational characteristics and outcomes such as racial/ethnic disparities in care.⁷⁹

IMPLICATIONS FOR POLICY AND PRACTICE

Although a great deal of research is clearly needed, this framework points to the importance of developing initiatives, at the provider, organizational, and policy level, to reduce the burden of provider cognitive load. At the provider level, one approach could involve interventions such as mindfulness training, which has been demonstrated to reduce stress and help providers regulate negative emotions,^{137–139} as well as training in other forms of stress management,¹⁴⁰ ideally as part of medical training. Another approach is to foster the automaticity of desired provider behaviors, including routine tasks as well as new scripts specifically designed to counteract or prevent known bias, including racial and ethnic bias. For example, providers might mentally simulate and rehearse new scripts to correct for common cognitive biases, including biases due to the inappropriate application of stereotypes.⁷

It is also possible to practice self-regulation of automatic prejudiced responses, so that self-regulation becomes automatized, by becoming aware of “prejudiced cues” and developing new responses to replace those initial responses with nonprejudiced responses.¹⁴¹ As discussed previously, automatic processes conserve cognitive load that can be used for controlled processing.¹⁴² Developing new scripts (or routines) requires rehearsal and practice of the desired behaviors in low cognitive load settings, while the operation of the script becomes automatized, before moving into settings with high levels of cognitive load, such as a busy clinic. Programs or courses designed to promote “reflective practice” or self-awareness offer the potential for providers to reflect on his or her automatic, habitual practices and, afterward (in a low cognitive load setting), identify areas for improvement and change.^{7,8,143,144}

This framework also points to key changes in the work environment to reduce chaos, improve work-flow, and increase providers’ sense of control over their work environment. This may require additional resources for increased staffing but likely will also require more thoughtful consideration of how new processes are implemented. For example, electronic medical record systems should be designed to minimize extraneous cognitive load.⁹⁴ Likewise, it is important to ensure that new initiatives (e.g., performance measurement) employ techniques used in other fields, such as cognitive task analysis to measure cognitive load.^{18,145} It is also important to avoid disparities-reduction interventions that, both of which may increase cognitive load. Increase interracial anxiety or that promote stereotype suppression.¹⁴⁶ On the flip side, “cognitive aids” (e.g., algorithms, checklists, clinical decision support tools) can reduce the burden of cognitive load.⁷ For instance, checklists can relieve providers of the mental burden of following newly introduced processes before they become automatized.^{147,148}

In the face of scarce resources it is also critical that these types of interventions are targeted at environments in which there is likely to be a great deal of cognitive load, such as systems that serve minority populations.¹⁰⁷ This would require broader changes in policies, such as the allocation of more resources to such systems as well as better reimbursement for primary care.¹⁰⁷ It is also important to consider the burden of cognitive load on trainees, whose performance is more likely to be adversely affected by high levels of load than providers with greater expertise.¹⁴²

CONCLUSION

There is scant research investigating the effect of organizational characteristics on disparities in healthcare.¹⁴⁹ I argue that incorporating the concept of cognitive load into health disparities research can advance the science by positing a potentially important mechanism through which a diverse range of features in the healthcare setting may affect provider bias. According to dual process models of cognition, cognitive load is a key determinant of the extent to which individuals will engage in automatic or controlled processes. Among healthcare providers, a greater reliance on automatic processes, such as stereotyping, is expected to be particularly disadvantageous for members of socially stigmatized groups and to contribute to disparities in care.^{20,23,24,150,151} The disproportionate burden of cognitive load experienced by providers who treat racial/ethnic minorities is also expected to result in poorer performance in tasks that require higher levels of executive functioning, such as medical decision making. Understanding the particular organizational characteristics that increase or decrease provider cognitive load would allow for the development of organizational-level interventions and policy changes to reduce racial and ethnic disparities in care. At a more general level, by positing a mechanism to link organizational, interpersonal, and intrapsychic phenomena, this model also provides a framework for more precisely examining the effect of a diverse range of organizational-level characteristics on medical decision making, potentially leading to valuable insights and advances.

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