Original Paper

EDAI Framework for Integrating Equity, Diversity, and Inclusion Throughout the Lifecycle of AI to Improve Health and Oral Health Care: Qualitative Study

Samira Abbasgholizadeh Rahimi[1,2,3,4*], PhD; Richa Shrivastava[5*], PhD; Anita Brown-Johnson[1,2], MDCM; Pascale Caidor[6], PhD; Claire Davies[7], PhD; Amal Idrissi Janati[2,8], DMD; Pascaline Kengne Talla[2], PhD; Sreenath Madathil[2], PhD; Bettina M Willie[2,]

Conclusions: The developed EDAI framework provides a comprehensive, actionable guideline for integrating EDI principles into AI development and deployment. By facilitating the systematic incorporation of these principles, the framework supports the creation and implementation of AI systems that are not only technologically advanced but also sensitive to EDI principles.

(J Med Internet Res 2024;26:e63356) doi: 10.2196/63356

KEYWORDS

equity, diversity, and inclusion; EDI; health care; oral health care; machine learning; artificial intelligence; AI

Introduction

Artificial intelligence (AI) is a branch of engineering and computer science that creates systems capable of performing tasks that typically require human intelligence such as visual perception, speech recognition, and language translation, while also analyzing complex datasets to identify patterns, make predictions, and solve problems across various domains [1-3]. AI technologies are increasingly being applied in all sectors of our society including health care systems [4-8]. These systems could be helpful in improving the effectiveness of health care delivery and facilitate achieving quadruple aims of care, that is, improved patient experience, better outcomes, lower costs, and improved clinical experience [9]. The introduction of AI in medicine and dentistry has shown promising potential [8,10,11] in screening, detection, and treatment of diseases [12,13]. AI enhances the use of electronic health records, supports clinical decision-making, and enables the development of sophisticated robots and devices to enhance care delivery and alleviate workload in health care systems [8,14].

The deployment of AI across various sectors has underscored the importance of ethical governance and the integration of equity, diversity, and inclusion (EDI) principles. Drawing on prior research from various industries, it is evident that AI technologies can both mitigate and exacerbate existing social biases, depending on their design and implementation [6,15,16]. This dual potential of AI, as highlighted in studies like Obermeyer et al [17], emphasizes the necessity for incorporating EDI principles from the onset of development to ensure technologies promote inclusivity and prevent social inequality. Moreover, research on algorithmic accountability underscores the need for transparency and explainability in AI systems, requiring designs that provide traceability of decisions and clear data use to comply with international regulations [18]. Additionally, insights into data privacy stress the importance of robust data protection practices

Although studies have identified limitations, to the best of our knowledge, no studies to date have explored the feasibility and challenges of incorporating EDI variables, concepts, practices, and outcomes within AI technologies in the field of health and oral health care. There is a need to explore how EDI principles can be integrated into the lifecycle of AI technologies and gain an understanding of the relevant stakeholders' perspectives on societal challenges and implementation of EDI in AI technologies for health care, oral health care, and related research. This study aimed to co-design the EDAI framework for integrating EDI throughout the lifecycle of AI in partnership with representatives of socio- or ethnocultural communities and end users, as well as with an international or intersectoral or interprofessional team of policy makers, researchers, clinicians, and industry representatives.

Methods

Study Design

Our research project began with a gap analysis and a comprehensive

Workshop Engagement Exercises

The workshops included plenary presentations, round table working groups, and focused group discussions as a research methodology [21,35]. At the preworkshop phase, to facilitate the exchange of ideas, research team members prepared a draft document relevant to the area of research and distributed it to meeting participants 2-3 weeks before the workshops [21].

- Workshop presentations: Individuals were selected from the attendees to provide presentations on their previous experiences in EDI to enhance the discussions. A semistructured focus group discussion guide was developed before the workshop based on a review of the literature and previous work of team members [21]. A panel presentation linked the presentations to focus groups and included expert opinions on these questions: (1) What are the visions and values that guide the integration of EDI throughout the lifecycle of AI? (2) What are the facilitators and barriers to the integration of EDI throughout the lifecycle of AI within health and oral health care? (3) What should be the indicators of EDI in health and oral health care data and how can we measure the EDI variables throughout the lifecycle of AI? and (4) How a conceptual framework should be framed and what are the main elements?
- Round table working groups and focused group discussions: The presentation session was followed by focused group discussion groups based on qualitative methodology and inductive reasoning [21]. The discussion groups answered the same questions that had been asked of the panel participants.

Each focus group had a moderator and notetaker with 5-6 purposefully selected participants with maximum variation and lasted for 45-60 minutes. Afterward, there was a large group discussion among the workshop attendees to further explore the subject and reach a consensus together. All proceedings notes were written by the notetakers. All the notes and memos were compiled for data analysis.

Workshop Conclusion

The workshops were concluded with a summary of the workshop by restating the main points and identifying components for preliminary data analysis.

Data Analysis

Data analysis was followed immediately after each workshop. An inductive thematic analysis was done manually (SAR, EE, and RS). As per Braun and Clarke [36], the analysis began with the generation and

Table 1. Summary of study phases and steps.

Phase and step	Details
Phase 1: gap analysis	
1. Scoping review	A comprehensive scoping review was performed to explore how EDI[a] principles are integrated into AI[b] studies in health and oral health care settings.
Phase 2: expert group workshops	
2. Establishing a multidisciplinary team	A multidisciplinary team was built through purposeful sampling with maximum variation, including stakeholders from diverse backgrounds (eg, engineering, dentistry, medicine, AI, ethics, and social sciences). The selection began 1 year before the first workshop. The team composition emphasized codevelopment, participatory approaches, and diversity in socio- or ethnocultural and geographical contexts.
3. Data collection	Both 2-day, in-person workshops involved focus group discussions to co-design the EDAI framework. Representatives from diverse backgrounds, including government, nongovernment organizations, minority communities, academia, and industry, participated. The workshop included plenary presentations, round table working groups, and focused group discussions, with preworkshop preparations such as draft documents distributed to participants. Focus groups addressed key questions on integrating EDI in the AI lifecycle, identifying facilitators and barriers, and defining EDI indicators and conceptual framework elements. Discussions were moderated, and notetakers documented all proceedings for data analysis.
4. Workshop conclusions	The workshops concluded with a summary and identification of components for preliminary data analysis.
5. Data analysis	Inductive thematic analysis was conducted manually. Initial codes were generated and sorted into potential themes, which were then refined and organized into key themes through collaborative efforts. The 8 phases of "conceptual framework analysis" (eg, mapping data sources, categorizing data, identifying concepts, and integrating concepts) were used. Constant comparative techniques were used to refine the coding, and the EDAI conceptual framework was organized into 3 main dimensions.
6. Validation	Validation and refinement of the conceptual framework were achieved through triangulation, reflexivity, and participant feedback via emails and digital meetings as well as during the second workshop.
Phase 3: framework development and stakeholder reviews	
7. Framework development	Based on workshop findings, the EDAI framework was developed and discussed with participants electronically. Feedback was iteratively incorporated to finalize the framework.

[a]EDI: equity, diversity, and inclusion.

[b]AI: artificial intelligence.

Results

Overview

We identified the knowledge gaps through a

Table 2. Coding data structure.

Initial codes	Focused codes	Theoretical codes	Core category	Final outcome
			Based on	To achieve quadruple aims of health care by ensuring equitable, diversified, and inclusive care

Table 3. Facilitators and barriers to integration of EDIa in AIb.

Level and facilitators	Barriers
At patients' level	
• Enhancing education and awareness regarding AI and EDI to alleviate patient resistance and fears. • Ensuring clear and transparent communication with patients about the purpose and process of data collection for AI model development. • Providing access and training of AI to patients.	• Resistance to AI integration can arise due to fear and intimidation stemming from complex technological jargon, concerns about potential job loss, and negative portrayals in popular media. Marginalized communities may exhibit heightened apprehension toward AI. • Limited technology training and lack of familiarity with AI applications, often exacerbated by low socioeconomic conditions. • Generational disconnect among users and technology knowledge gap. • Privacy concerns regarding patient consent.
At health care providers' level	
• Implementation of training programs and knowledge enhancement initiatives for health care providers. • Creation of ethical guidelines and policy frameworks concerning the collection and use of patient data.	• Lack of EDI and AI literacy and understanding among health care providers.
At AI developers' level	
• Fostering the inclusion of diverse perspectives in AI development and implementation and involving affected communities during the conceptualization stage—ensuring AI solutions address their specific needs and concerns. • Identifying inclusive data and adopting participatory, community-oriented approaches in data collection—ensuring inclusivity and representation. • Continuous feedback and evaluation of AI algorithms to correct biases and improve reliability. • Adopting a transparent approach in the AI development stage to build trust and facilitate EDI integration. • Asking the right questions focused on the problem rather than the technology can lead to more relevant and impactful AI solutions.	• Limited knowledge and research on dimensions of EDI result in challenges in defining and categorizing diverse groups. • Bias and discrimination embedded in human data and missing data can lead to biased AI predictions. • Inadequate representation of diverse groups in the development process can lead to biased AI solutions. • Misconduct in responsible research and data misuse. • Limited resources for developing AI tools with integrated EDI can hinder progress.
At policy makers' level	
• Having political will and financial support from policy makers can facilitate the identification of AI needs and the development of inclusive and equitable AI. • Supportive policy and regulation frameworks for responsible and fair AI development and implementation.	• Lack of policy frameworks around integration of EDI through the lifecycle of AI. • The lack of regulatory authority and governance can create challenges in assessing AI integration from an EDI perspective, potentially leading to ethical and fairness concerns. • Politicians exerting pressure about how society is using or will use AI, often for political gain. • The current education system may limit diversity in AI developer groups.
At all stakeholders' level	
• Connecting end users' needs with stakeholders to facilitate EDI integration. • AI literacy and educating stakeholders at all levels, including users, providers, and the community, about AI and its implications can build a better understanding and acceptance of AI solutions.	• The lack of common vocabulary among different professionals, such as researchers, clinicians, AI developers, and consumers, can create obstacles in integrating EDI within the lifecycle of AI. • AI's potential to generate wealth may exacerbate societal disparities, with power dynamics among stakeholders influencing AI and EDI control. • Privacy concerns related to data ownership.

[a]EDI: equity, diversity, and inclusion.

[b]AI: artificial intelligence.

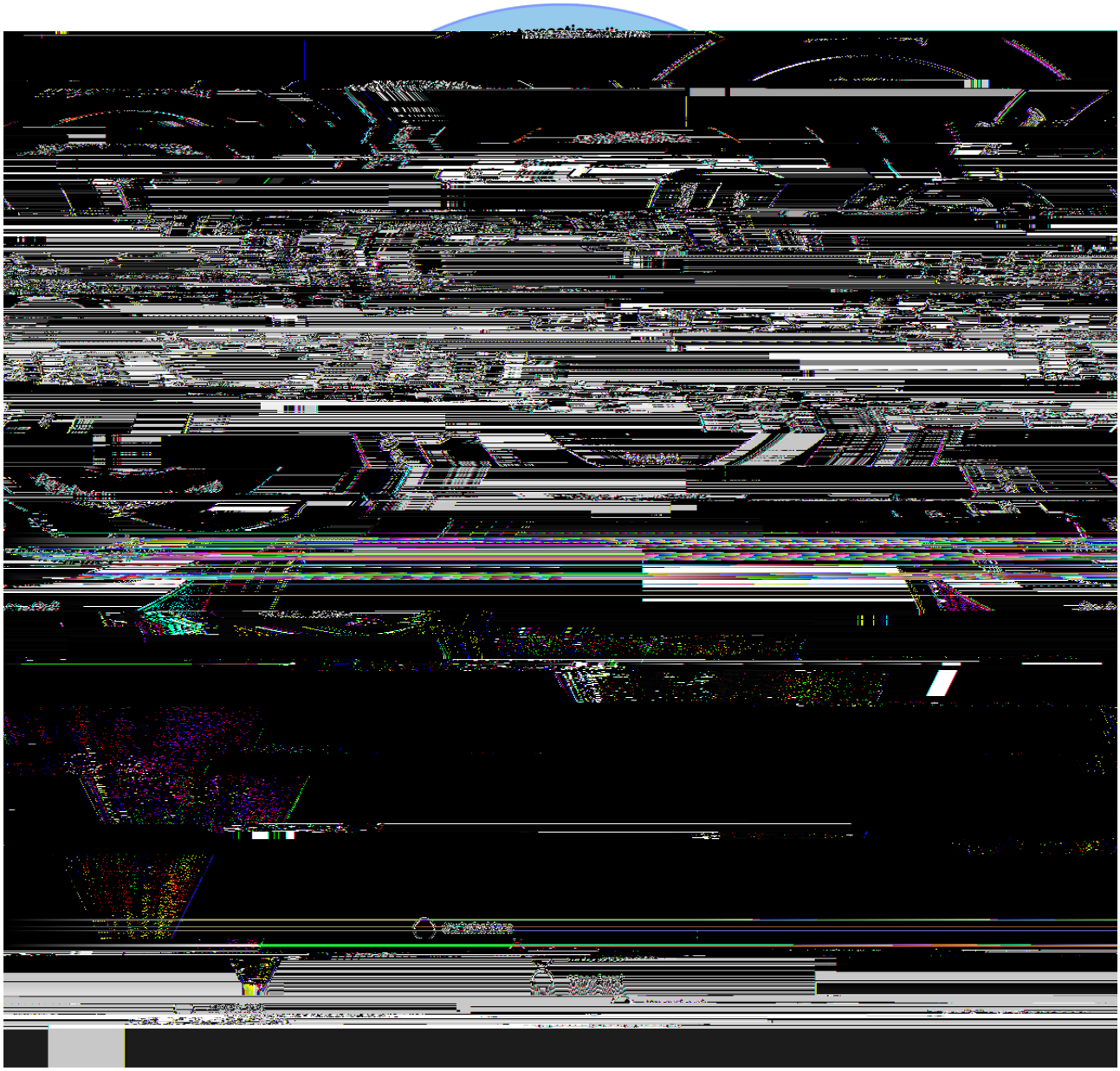
Theme 4: The Indicators of EDI in Health and Oral Health Care Data and Their Measurement

We identified the EDI indicators through a past scoping review, the results of which were published in another paper [22]. During the workshop, participants categorized the EDI indicators in health and oral health care into 3 levels: individual (micro level), community (meso level), and society (macro level). Table 4 details the identified EDI indicators under categorized levels.

Table 4. Refinement of the conceptual EDAI framework.

Levels and indicators	Details
Micro level (individual level)	
	Age, gender, residence, education level, occupation, income, marital

Figure 1. The proposed EDAI framework. AI: artificial intelligence.



At the macro level, focusing on intersectionality can aid in understanding the complex interactions of various factors at micro and meso levels, thereby striving to achieve social justice. Integration of EDI within the lifecycle of AI should emphasize decolonization by minimizing the impact of settler colonialism, racism, and discrimination and acknowledging the historical injustices and systemic inequalities that have impacted marginalized

However, it is distinct from EDI in AI, which extends beyond ethical considerations to emphasize the integration of EDI throughout the AI lifecycle. Consideration of EDI not only aims to prevent biases but also ensures diverse representation and targets social equity and inclusivity.

Despite the advantages of AI, there are some concerns that underscore the necessity of consciously integrating EDI principles into the lifecycle of AI systems to ensure they are socially responsible and equitable. These concerns include discrimination, unfair treatment, and risks of developing or intensifying health-related inequalities [41]. Recent systematic reviews of EDI in AI found a lack of EDI considerations in the dataset and AI-based academic literature and a lack of EDI

systems designed and implemented under the EDAI framework can optimize resource allocation and patient scheduling to prioritize accessibility and minimize disparities in care delivery. Furthermore, this framework can guide the development of AI tools for patient education and engagement, ensuring that materials are culturally relevant and accessible to all, thereby improving health literacy and patient autonomy across diverse communities.

Strengths and Limitations

One of the strengths of this research work is its systematic approach and the intersectoral and multidisciplinary team. The team members were consciously selected to represent excellence in research activities and leadership and diversity in socio- or ethnocultural and geographical contexts. The team's composition is in line with the participatory approach and the concept of codevelopment, which are at the core of this project. Moreover, the EDAI framework also attempts to understand the linkages among various indicators at individual, organizational, and system levels. However, this study has a few limitations. First, while we were unable to record the workshop sessions due to logistical constraints, detailed notes were diligently taken by designated notetakers to ensure the accuracy and richness of the data. Second, despite our efforts, we were not able to engage First Nations and Aboriginal people in this initial phase. However, we did include a divage

4. Panda P, Bhatia V. Role of artificial intelligence (AI) in public health. Indian J Community Fam Med. 2018;4(2):60. [doi: 10.4103/2395-2113.251442]
5. Rajpurkar P, Chen E, Banerjee O, Topol EJ. AI in health and medicine. Nat Med. 2022;28(1):31-38. [doi: 10.1038/s41591-021-01614-0] [Medline: 35058619]
6. Lin SY, Mahoney MR, Sinsky CA. Ten ways artificial

29. Charmaz K. The genesis, grounds, and growth of constructivist grounded theory. In: Developing Grounded Theory: The Second Generation Revisited. 2nd Edition. New York, NY. Routledge/Taylor & Francis Group; 2021.
30. Ralph N, Birks M, Chapman Y. The methodological dynamism of grounded theory. Int J Qual Meth. 2015;14(4):160940691561157. [doi: 10.1177/16094069156115 76]
31. Jabareen Y. Building a conceptual framework: philosophy, definitions, and procedure. Int J Qual Meth. 2009;8(4):49-62. [doi: 10.1177/160940690900800406