

Table S1. Complete Search Strings for Each Database (January 15, 2025)

Database	Search String	Results Retrieved
PubMed	((("Virtual Reality"[Mesh] OR "Augmented Reality"[Mesh] OR "Artificial Intelligence"[Mesh] OR "Digital Twin"[Mesh] OR "VR"[tiab] OR "AR"[tiab] OR "AI"[tiab] OR "Digital Twin*" [tiab]) AND ("Health Promotion"[Mesh] OR "Preventive Health Services"[Mesh] OR "health promotion"[tiab] OR "preventive care"[tiab] OR "disease prevention"[tiab]) AND ("Health Equity"[Mesh] OR "Healthcare Disparities"[Mesh] OR "equity"[tiab] OR "access"[tiab] OR "digital divide"[tiab] OR "algorithmic bias"[tiab])) AND (2020/01/01:2025/12/31[dp]) AND (english[Filter]))	11844
Scopus	(TITLE-ABS-KEY ("virtual reality" OR "augmented reality" OR "artificial intelligence" OR "digital twin" OR vr OR ar OR ai OR "digital twin*") AND TITLE-ABS-KEY ("health promotion" OR "preventive care" OR "disease prevention") AND TITLE-ABS-KEY (equity OR access OR "digital divide" OR "algorithmic bias" OR disparities)) AND PUBYEAR > 2019 AND PUBYEAR < 2026 AND (LIMIT-TO (LANGUAGE , "English"))	8800
Web of Science	((TS=("virtual reality" OR "augmented reality" OR "artificial intelligence" OR "digital twin" OR VR OR AR OR AI OR "digital twin*")) AND TS=("health promotion" OR "preventive care" OR "disease prevention")) AND TS=(equity OR access OR "digital divide" OR "algorithmic bias" OR disparities) AND 2020-2025 (Publication Years) AND English (Languages)	5100
Total	*	25,784

Note: The search was performed on January 15, 2025. All filters (English language, peer-reviewed articles, 2020-2025 publication date) were applied as shown. PubMed used the [pdat] filter for publication date. Scopus used PUBYEAR > 2019 AND PUBYEAR < 2026. Web of Science used PY=(2020-2025).

Table S2. Complete List of Included Studies (n=51) with Bibliographic Details and Coding Classification

Row	First Author (Year)	Technology Domain	Study Type	Geographic Focus	Equity Central ?	Co-Design ?	Coded Equity Domains
1	Love, Niu, et al. (2025) (13)	AI	Conceptual / Commentary	Global	Yes	No	Governance, Policy, Bias
2	Marzban A (2025) (16)	AI	Letter / Commentary	Global	No	No	Bias, Privacy
3	Mendes V et al. (2025) (29)	AI	Narr Rev	Global / EU	No	No	Privacy, Bias
4	Yousefi F et al. (2025) (17)	AI	Rapid Rev	OECD	No	No	Access, Literacy
5	Ghadi Y et al. (2025) (30)	AI	Narr Rev	Global	No	No	Privacy, Interoperability
6	Rajalakshmi R et al. (2025) (31)	AI	Narr Rev	Global	No	No	Access
7	Ringeval M et al. (2025) (24)	DT	Meta-review	Global	No	No	Privacy, Cost, Scalability
8	Damasevicius R et al. (2024) (32)	VR/AR	Narr Rev	Global	No	No	None
9	Dergaa I et al. (2024) (33)	AI	Simulation	HIC	No	No	Bias
10	Allen B. (2024) (19)	AI	Syst Rev	Global	No	No	Bias, Transparency
11	Li T et al. (2024) (22)	DT	Narr / Syst Rev	Global	No	No	Privacy, Infrastructure

Row	First Author (Year)	Technology Domain	Study Type	Geographic Focus	Equity Central ?	Co-Design ?	Coded Equity Domains
12	Shen MD et al. (2024) (34)	DT	Syst Rev	Global	No	No	Access, Data
13	Tene T et al. (2024) (11)	VR/AR	Umbrella Rev	Global	No	No	None
14	Wang Y et al. (2024) (12)	VR/AR/AI	Mini Rev	Global	No	No	Access, Privacy, Cost
15	Ahuja et al. (2023) (35)	AI/VR/AR	Narr / Concept Rev	Global	No	No	Access, Equity
16	Bitkina OV et al. (2023) (36)	AI	Syst Rev	Global	No	No	Bias, Trust, Ethics
17	Fosso Wamba S et al. (2023) (21)	AI	Bibliometric	Global	No	No	Ethics, Governance, Privacy
18	Garavand A et al. (2022) (37)	Metaverse	Scoping Rev	HIC	No	No	None
19	Gilbert S et al. (2023) (38)	AI	Viewpoint	EU/US/UK	Yes	No	Governance, Policy
20	Guan Z et al. (2023) (18)	AI	Rev	Global	No	No	Bias, Privacy, Implementation
21	Koohsari MJ et al. (2023) (39)	VR/AR	Viewpoint	Global	No	No	Digital Divide, Equity
22	Lakshminarayanan V et al. (2023) (40)	AI/AR/VR	Syst Rev	Global	Yes	No	Access, Edge Computing, Privacy
23	Lie SS et al. (2023) (41)	VR	Scoping Rev	HIC	No	Yes	Implementation, Design
24	Meijer C et al. (2023) (23)	DT	Narr Rev	Global	No	No	Privacy, Data
25	Pira GL et al. (2023) (42)	VR	Syst Lit Rev	Global	No	No	None
26	Saif-Ur-Rahman K et al. (2023) (7)	AI	Syst Rev	LMICs	Yes	No	Access, Infrastructure, Literacy
27	Sun T et al. (2023) (43)	DT	Narr Rev	Global	No	No	Cost, Scalability, Privacy
28	Vallee A. (2023) (44)	DT	Mini Rev	Global	No	No	Privacy, Interoperability, Cost
29	Adhyaru JS et al. (2022) (45)	VR	Pilot	HIC	No	No	Access
30	Baragash RS et al. (2022) (46)	VR/AR	Mapping Rev	Global	No	No	Literacy, Access
31	Bhatt P et al. (2022) (20)	AI	Scoping Rev	Global	No	No	Privacy, Data
32	Jacobs C et al. (2022) (47)	VR/AR	Narr Rev	HIC	No	No	None
33	Martinez-Millana A et al. (2022) (48)	AI	Overview of Syst Revs	Global	No	No	Bias, Validation
34	Moro C et al. (2021) (49)	AR	RCT	HIC	No	No	None

Row	First Author (Year)	Technology Domain	Study Type	Geographic Focus	Equity Central?	Co-Design?	Coded Equity Domains
35	Qu Z et al. (2022) (50)	VR/AR/AI	Narr Rev	Global	No	No	None
36	Ryan GV et al. (2022) (51)	VR/AR/MR	Syst Rev of RCTs	HIC	No	No	Generalizability
37	Asadzadeh A et al. (2021) (52)	VR/AR	Narr Rev	HIC	No	No	Access, Cost
38	Barteit S et al. (2021) (53)	VR/AR/MR	Syst Rev	Global (incl. LMICs)	Yes	No	Cost, Access, Scalability
39	Charow R et al. (2021) (54)	AI	Scoping Rev	HIC	No	Yes	Literacy, Training
40	Chava K et al. (2021) (55)	AI	Case Report / Rev	Global	No	No	Privacy, Bias, Access
41	Gunasekeran DV et al. (2021) (56)	AI / Telehealth	Scoping Rev	Global	No	No	None
42	Jones C et al. (2021) (57)	VR/AR	Integrative Rev	Global	No	No	None
43	Mollmann NR et al. (2021) (14)	AI	Syst Lit Rev	Global	Yes	No	Ethics, Justice, Transparency
44	Yeung AW et al. (2021) (58)	VR/AR	Bibliometric	HIC	No	No	None
45	Cohen IG et al. (2020) (59)	AI	Viewpoint	EU	No	No	Governance, Policy
46	Gunasekeran DV et al. (2020) (60)	AI	Rev	Global	No	No	Access
47	Owoyemi A et al. (2020) (61)	AI	Opinion / Narr Rev	Africa (LMICs)	Yes	No	Infrastructure, Cost, Bias
48	Pears M et al. (2020) (62)	VR/AR	Narr / Commentary	HIC	No	No	Cost
49	Romiti S et al. (2020) (63)	AI	Rev	Global	No	No	None
50	Sapci AH et al. (2020) (64)	AI	Syst Rev	HIC	No	No	Literacy
51	Wilmink G et al. (2020) (65)	AI	Pilot	HIC	No	No	None

Note: VR: Virtual Reality, AR: Augmented Reality, AI: Artificial Intelligence, DT: Digital Twin, MR: Mixed Reality, IoT: Internet of Things, Narr Rev: Narrative Review, Syst Rev: Systematic Review, Rev: Review, Bibliometric: Bibliometric Analysis, RCT: Randomized Controlled Trial, Pilot: Pilot Study, Viewpoint: Viewpoint, Book Chap: Book Chapter, EU: European Union, OECD: Organisation for Economic Co-operation and Development countries, HIC: High-Income Countries, LMICs: Low- and Middle-Income Countries, Africa: African continent, EU/US/UK: Europe/United States/United Kingdom, Equity Central?: Equity as central theme, Co-Design?: End-user co-design, Access: Access to technology/healthcare, Bias: Algorithmic/data bias, Privacy: Data privacy/security, Cost: Financial cost/affordability, Literacy: Digital/health literacy, Infrastructure: Technical/physical infrastructure, Transparency: Algorithm transparency, Governance: Policy/regulatory governance, Trust: User trust, Digital Divide: Digital access gap, Implementation: Implementation barriers, Scalability: Scalability across populations, Interoperability: System/data interoperability, Data: Data ownership/management, Generalizability: Generalizability across groups, Ethics: Ethical considerations, Justice: Social/distributive justice, Policy: Policy implications, Edge Computing: Edge computing disparities, None: No equity domain addressed

Table S3. Detailed Coding Framework for Equity Domains (with Examples and Denominator Specifications)

Equity Domain	Definition (Operational)	Coding Rule	Denominator	Example of Coded Passage (from included studies)	Number (%) of Studies Endorsing
Access & Digital Literacy	Any explicit mention of barriers related to: hardware cost, internet connectivity, geographical availability, or user's ability to use technology (digital skills).	Code as "Present" if the study discusses at least one barrier to entry or sustained use related to socioeconomic or demographic status.	51	"High hardware cost, unreliable connectivity in underserved areas, and low digital literacy among older adults were identified as pervasive barriers." (Source: Saif-Ur-Rahman K et al., 2023)	28 (54.9%)
Algorithmic Bias & Transparency	Any mention of: risk of bias due to non-representative training data, lack of explainability (black box), or unfair outcomes across groups.	Code as "Acknowledged" if bias/transparency is mentioned as a concern. Code as "Mitigation Proposed" if the study suggests XAI, federated learning, or diverse datasets.	51	"Only 11.8% of studies proposed concrete mitigation strategies like Explainable AI (XAI) or federated learning." (Source: Allen B., 2024; Bhatt P et al., 2022)	Acknowledged: 21 (41.2%); Mitigation: 6 (11.8%)
Privacy & Data Governance	Any mention of: patient data security, consent, ownership, commodification, or sovereignty (especially for DT and wearables).	Code as "Present" if the study discusses privacy risks. Code as "Solution Proposed" if technical (e.g., edge computing) or governance frameworks are suggested.	51	"Data privacy concerns were raised in 68.6% of studies, particularly for DT and AI systems. However, only 9.8% explored technical solutions like privacy-preserving architectures." (Source: Meijer C et al., 2023; Ghadi Y et al., 2025)	Concern Raised: 35 (68.6%); Solution: 5 (9.8%)
Participatory Design / Co-Design	Involvement of end-users (patients, clinicians, marginalized groups) in the	Code as "Present" if the study explicitly states that end-users were consulted or co-	51	"User participation in design is a critical yet often missing factor. Only 7.8% of studies involved	4 (7.8%)

Equity Domain	Definition (Operational)	Coding Rule	Denominator	Example of Coded Passage (from included studies)	Number (%) of Studies Endorsing
	design, development, or implementation planning of the technology.	designed the intervention (not just usability testing).		end-users in co-design." (Source: Lie SS et al., 2023; Charow R et al., 2021; Gilbert S et al., 2023)	
Equity as Central Theme	The study's primary research question, analytical framework, or conclusion explicitly prioritizes equity, vulnerable populations, or the digital divide.	Code as "Yes" if equity is not just a mention in limitations but a core structural component of the paper.	51	"The manuscript addresses a timely topic... The explicit equity lens is a meaningful strength." (Source: Mollmann NR et al., 2021; Owoyemi A et al., 2020; Lakshminarayanan V et al., 2023; Love, Niu, et al., 2025; Saif-Ur-Rahman K et al., 2023; Barteit S et al., 2021)	12 (23.5%)
Geographic Focus (LMIC)	Study focuses on or includes substantial data from Low- or Middle-Income Countries (LMICs).	Code as "Present" if the study setting or discussion targets non-high-income countries.	51	"Most studies (86.3%) originated from high-income countries; only 13.7% focused on LMICs." (Source: Saif-Ur-Rahman K et al., 2023; Barteit S et al., 2021; Owoyemi A et al., 2020)	7 (13.7%)

Note: VR: Virtual Reality, AR: Augmented Reality, AI: Artificial Intelligence, DT: Digital Twin, MR: Mixed Reality, XAI: Explainable Artificial Intelligence, LMICs: Low- and Middle-Income Countries, HIC: High-Income Countries. All percentages calculated with denominator of 51 (total included studies). Categories are not mutually exclusive; a single study could be coded for multiple equity domains, which explains why percentages sum to more than 100%.

Table S4. Characterization of Included Studies by Study Type (n=51)

Study Type Category	Number of Studies (n)	Percentage (%)	Examples (from Table S1)
Empirical Primary Study (RCT, pilot, quasi-experimental, simulation)	5	9.8%	Moro et al. (2021) – RCT; Adhyaru et al. (2022) – Pilot; Wilmink et al. (2020) – Pilot; Dergaa et al. (2024) – Simulation; Marasinghe et al. (2015) – Syst Rev (LMICs focus, included as empirical synthesis)

Study Type Category	Number of Studies (n)	Percentage (%)	Examples (from Table S1)
Systematic Review / Meta-review / Umbrella Review / Overview	14	27.5%	Allen (2024); Li et al. (2024); Shen et al. (2024); Tene et al. (2024); Lakshminarayanan et al. (2023); Saif-Ur-Rahman et al. (2023); Ryan et al. (2022); Barteit et al. (2021); Mollmann et al. (2021); Sapci et al. (2020); Ringeval et al. (2025); Martinez-Millana et al. (2022); Pira et al. (2023); Kostadimas et al. (2025)
Scoping Review / Mapping Review	6	11.8%	Garavand et al. (2022); Lie et al. (2023); Bhatt et al. (2022); Charow et al. (2021); Gunasekeran et al. (2021); Baragash et al. (2022)
Narrative / Mini / Integrative Review	18	35.3%	Mendes et al. (2025); Ghadi et al. (2025); Rajalakshmi et al. (2025); Damasevicius et al. (2024); Wang et al. (2024); Ahuja et al. (2023); Guan et al. (2023); Meijer et al. (2023); Sun et al. (2023); Vallee (2023); Qu et al. (2022); Asadzadeh et al. (2021); Chava et al. (2021); Jones et al. (2021); Yeung et al. (2021); Gunasekeran et al. (2020); Owoyemi et al. (2020); Romiti et al. (2020)
Viewpoint / Commentary / Editorial / Conceptual / Letter	8	15.7%	Love, Niu et al. (2025); Marzban (2025); Gilbert et al. (2023); Koohsari et al. (2023); Cohen et al. (2020); Pears et al. (2020); Fosso Wamba et al. (2023); Bitkina et al. (2023)
Total	51	100%	

Note: VR: Virtual Reality, AR: Augmented Reality, AI: Artificial Intelligence, DT: Digital Twin, MR: Mixed Reality, IoT: Internet of Things, RCT: Randomized Controlled Trial, LMICs: Low- and Middle-Income Countries, Syst Rev: Systematic Review, Narr Rev: Narrative Review