Artificial Intelligence in migrant health: a critical perspective on opportunities and risks

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Summary

Rapid advances in Artificial Intelligence (AI) are leading to the proliferation of health applications. AI presents both opportunities and risks for migrants, including refugees, and asylum-seekers. This Personal View provides a critical perspective on opportunities and risks of using AI in migrant health. It synthesises literature insights to highlight the potential health benefits of AI, for both the general population and migrants, in areas including information retrieval, translation, education, empowerment, disease prevention and diagnosis, and personalised treatments. It addresses risks posed by AI, including the potential for tracking and monitoring individuals, which could threaten the anonymity and freedom of those using digital services, as well as the perpetuation or exacerbation of biases in the algorithms used. Current deficiencies in AI, including issues of quality and tendencies to sometimes invent data, as well as to reinforce existing biases and discriminatory processes, may also adversely impact on various groups of migrants coming from different parts of the world, compounding existing ethical challenges. Given the high level of digital infrastructure and opportunities for coherent policy-making and regulatory control within the region, Europe can provide leadership in developing guidelines, policies and agreements ensuring that AI serves migrants' health needs while not compromising their rights.

Introduction

Migration, health, and AI

The expanding use of digital technologies (hardware and software) in health offers significant benefits for migrants, including refugees and asylum-seekers—particularly those with limited access to in-person health services.[1] However, it also raises questions about issues of equity in access to and ethics of employment of these tools. Their use may expose migrants to additional risks beyond those faced by the general population, such as surveillance, tracking, and identification through digital systems, including those using Artificial Intelligence (AI). Such use can increase vulnerability to arrest, confinement, deportation, exploitation, and abuse.[2] The potential risks and benefits of digital technologies in general for the health of migrants in the European region has been discussed.[1] Many of the issues raised by the application of digital tools, including those incorporating AI, for migrant health affect health and healthcare in general, with migrants representing an example of special interest groups where particular issues are made visible or are amplified.

In this Personal View, we consider various migrant groups and explore both opportunities and risks related to AI applications. We emphasise that even migrants with regular status experience different benefits and risks depending on their backgrounds, cultures, skills, and access to hardware and software. For those with irregular or pending migration status, vulnerabilities increase, and AI use by health professionals, researchers, humanitarian agencies, or border control may raise risks of detention and deportation to unsafe places.[2] Each migrant has unique circumstances, needs for health information and services, and varying access, constraints, vulnerabilities, and fears regarding service use.[1] Therefore, it is essential to clearly define who is

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considered a 'migrant' and recognise different migrant categories in each context. Panel 1 summarises commonly used migrant-related terminology and key international agreements on their rights and status.

This Personal View reflects on the role of AI in migrant health, synthesising insights from existing literature and expert perspectives. Rather than conducting a systematic review, it discusses key challenges, risks, and opportunities based on relevant studies and policy discussions. The aim is to offer a conceptual perspective for understanding AI's impact on migrant health, highlighting both the potential benefits and challenges, and outlining principles and action areas to guide future development—particularly emphasising Europe's potential leadership in this evolving field.

While migration, digital health technologies, and applications of AI in health and migration are all phenomena of global importance, they also have features that are shaped by local contexts and conditions. Europe is at the forefront of many of these developments, with high levels of digital technology use among the general population, growing integration of digital tools in well-developed national health systems, and a collective regulatory approach to AI within the EU. Europe is also a major destination for migrants from a wide range of countries and regions and is increasingly employing AI in the management of migration.[4] The opportunities and pressures emerging within Europe, along with its potential to advance the use and governance of AI in health while safeguarding human rights, equity and social justice, including for refugees, make the region a particularly valuable case for examination and a potential source of insight for other parts of the world that are grappling with similar challenges.

Panel 1: Who is a migrant?

As discussed by the International Organization for Migration (IOM),[3] the umbrella term 'migrant' lacks an internationally agreed definition and carries limited obligations regarding the rights of individuals who have moved from their country. The term is employed by IOM to cover persons who move away from their place of usual residence, whether within a country or across an international border. In this Personal View, we use the term to refer to those who have crossed an international border to live elsewhere, while some of the issues raised here may also apply to internal migrants and/or internally displaced persons. 'Migrant' describes people in a wide spectrum of situations, including those moving with or without documentation such as personal identity papers and documents confirming rights or permissions to visit, reside, work or study in the place in which they are currently located. In addition to being covered generally by human rights instruments including the UN Universal Declaration of Human rights and, where relevant, UN Convention on the Rights of the Child, particular categories of migrants may have precise definitions that have been internationally negotiated and may be the subject of international agreements according them rights relating to protection, asylum, residence, work or study.

Legally recognised definitions and agreements are of importance because the status of individual migrants may affect both their entitlements and actual or perceived vulnerabilities—factors which intersect with the risks and opportunities associated with AI. Migrating people are not homogeneous in nature and their situations may differ appreciably as a result, in particular, of two sets of considerations:

- **Characterisation by the systems they encounter**: Individuals who are forced to move due to war or political conflict, such as refugees and asylum-seekers, have rights which are enshrined by the 1951 Refugee Convention and its 1967 Protocol and the 1984 Cartagena Declaration, although in practice, there is considerable variation in the extent to which they are upheld by countries that are signatories of these international agreements, including among member states of the European Union (EU). Individuals who are recognised as refugees have increased access to assistance from States, UNHCR, and other organisations, including with respect to access to healthcare. While awaiting assessment of their claim, asylum seekers may be placed under considerable restrictions with regard to accommodation, freedom to move about and access to work and services. Migrants also includes other categories that are legally defined, such as internationally displaced persons, migrant workers and smuggled migrants, as well as those whose status or means of movement are not specifically defined under international law, such as immigrants (migrants given permission to live permanently in a country) and international students.[3] Migrants in a "regular" situation—who have been granted State permission to work, study or reside in another country—are addressed in the Global Compact for Safe, Orderly and Regular Migration, a non-binding document that respects States' sovereign right to determine who enters and stays in their territory. They are subject to the State's laws, which may restrict their access to the full range of services, including in health, that are available to the general population. "Irregular" or "undocumented" migrants are usually excluded from official work and lack entitlement to State services, such as health, except in emergency situations. Displaced persons are those who have been forced or obliged to flee or to leave their home or place of habitual residence, either across an international border or within a State, in particular as a result of or in order to avoid the effects of armed conflict, situations of generalised violence, violations of human rights or natural or human-made disasters. While those displaced internationally may become refugees or asylum seekers, internally displaced persons do not have a special status in international law with rights specific to their situation, but are often highly vulnerable and at risk of abuse of their basic rights.
- **Individual histories and personal characteristics**: Migrants are individuals with a spectrum of different levels of attainments, competencies and skills across all areas, including education, work, and capacity to use digital tools. Their health may have been affected in different ways by personal histories of upbringing and experiences endured along the migration pathway, including hunger, physical and mental abuse, injury and lack of access to timely treatment. Their cultural and social backgrounds and present circumstances may include constraints on their freedom of action (e.g., due to gender, ethnicity or race).

Possibilities of AI for health

The scope and potential power of applications of digital technologies to affect human society in general is currently increasing very rapidly due to the incorporation of AI (Panel 2). A burgeoning range of applications across many fields of human endeavour has been seen. The ability to replace or support human labour, enhance teaching and learning, accelerate decision-making, improve communication across distances and language barriers, foster innovation, and address complex systems-level problems involving multiple variables are widely cited as potential benefits.[5,6]

Risks of AI

Alongside the enormous potential benefits of AI, there are several issues of concern as AI technology advances and new applications emerge. Some are intrinsic to the present stage of development of the underlying technology itself. Others relate to the varied environments and conditions in which AI is applied, shaped by local economic, legal, political, regulatory, and social contexts. These include factors within organisations and communities, as well as the personal circumstances of each individual affected by the application. These issues of concern are highlighted as generic factors in Panel 3 and then referred to in subsequent sections in the contexts of health of the population generally and of migrants in particular, where they have broad implications for the ethics of using AI in different circumstances.

One approach to addressing the risk of AI providing inaccurate outputs and the difficulty many AI modelling techniques present for human understanding has been the development of Explainable AI (XAI). XAI aims to enable human oversight of AI algorithms by clarifying the reasoning behind their decisions or predictions, making them more transparent, trustworthy and accountable, particularly in sensitive areas such as healthcare, finance or security. A systematic review of XAI from an end user's perspective described five dimensions of XAI effects: trust, transparency, understandability, usability, and fairness. It identified several research gaps and proposed future research agendas, addressing standardisation practice, representing XAI, and the overall impact on users.[17] The need for XAI in the use of AI in government and public service functions, including in relation to immigration and the employment of automated decision-making, has been emphasised,[18] while there has also been some scepticism about whether XAI has yet realised the goals of understandable, trustworthy, and controllable AI in practice.[19] The application of XAI to automated decision-making regarding the status or health of migrants cannot be justified until there is clear evidence of its safety and trustworthiness.

Large impacts of the substantial step-change in computational power represented by AI are already being seen in the health field, adding greatly to the interest in applying AI to support the health of migrants.[20] However, as discussed in the article by Matlin et al.[1] on digital solutions for migrant health, the actual benefits and disadvantages associated with each digital application depend, among other factors, on where, how and by whom it is used.

Among serious challenges that have emerged is the potential for AI to discriminate against historically

Panel 2: **Artificial Intelligence: concepts, constituents, and capacities.**

Artificial Intelligence: the concept of simulation of aspects of human intelligence by machines, involving computer systems able to perform tasks that historically required human intelligence, such as:

- visual perception and pattern recognition
- speech recognition and synthesis
- translation between languages
- problem solving and decision-making
- deduction of associations or relationships and drawing conclusions from analysis of large data sets

The OECD[7] defines an AI system as a machine-based system that, for explicit or implicit objectives, infers, from the input it receives, how to generate outputs such as predictions, content, recommendations, or decisions that can influence physical or virtual environments. Different AI systems vary in their levels of autonomy and adaptiveness after deployment.

Aspects of AI include the discipline of **machine learning** (ML), which uses algorithms to parse and learn from data to make informed decisions, and **deep learning**, a sub-discipline of ML that structures algorithms in layers to create an **artificial neural network** (**deep neural network**) which can simulate the complex decision-making power of the human brain to learn and make intelligent decisions on its own.

While AI has been under development for more than half a century, a range of technological innovations in both hardware and software have been driving rapid expansions in many AI capacities within the last decade. Of particular note are the large-scale use of **graphic processor units** to accelerate deep neural networks and **large language models** (LLMs) (very large deep learning models, pre-trained on vast amounts of data, trained for different tasks in **natural language processing**) that lead to **generative AI**—technologies capable of creating new, diverse outputs such as images, music, text, and synthetic data, with one example being **chatbots** such as ChatGPT version GPT-4 that process and simulate human conversation.

Panel 3: Artificial Intelligence: underlying factors of concern.

As AI has emerged into widespread use in a host of fields, several issues have gained prominence that relate to AI accuracy, impartiality, privacy, transparency, and trust.[8]

Fictitious data

With the sudden explosion in use of chatbots, it has become evident that LLMs can present fictional results. As Mittelstadt et al.[9] have explained, "LLMs are designed to produce helpful and convincing responses without any overriding guarantees regarding their accuracy or alignment with fact" and "the concept of 'truth' has been highly simplified in LLM development and equated with accuracy measured against the 'ground truth' of the training data".

At least three types of sources of incorrect data output by chatbots have been identified:

- Incorrect information contained in the large data sets on which they are trained. In addition to historic accumulation of errors in available data sets, a further problem is created when AI is itself used to generate text to expand the number of available training sets. This can lead to the LLM producing nonsense, or 'model collapse'.[10]
- Unethical use of AI tools to create fake data sets, such as data to be used to support or negate a scientific hypothesis.[11]
- 'Confabulations', 'delusions' or 'hallucinations' spontaneously generated within a neural network without explicit external inputs. By 2023, analysts estimated that chatbots hallucinate as much as 27% of the time, with factual errors present in 46% of their responses. Inconsistency/lack of reproducibility of responses to the same question is also observed. Examples of serious consequences have included generation of fictitious case reports used in legal cases, invented references contained in published scientific papers and invented information about misbehaviour by individuals.[12] A worrying trend revealed in a study by Zhou et al.[13] has been that current approaches to scale-up of LLMs are resulting in them becoming less reliable and the authors called for "a fundamental shift in the design and development of general-purpose artificial intelligence, particularly in high-stake areas".

Spreading misinformation and disinformation

AI has the potential to generate false or inaccurate information (misinformation) itself through spontaneous 'hallucinations' and to be used to generate false information which is deliberately intended to mislead ("disinformation"). Linked with the dissemination of false information through a range of channels, including social media, targeted messaging and scientific journals, the capacities of AI to generate, convincingly frame, spread and amplify misinformation and disinformation has been identified in the World Economic Forum's Global Risk Report 2024 as the leading short-term risk for global destabilisation.[14]

Bias

The impartiality of conclusions reached by AI applications depends intrinsically on the use of data sets that are not biased or incomplete and on assumptions built into the algorithms that search for, select and analyse the data. Data bias may include skewed data which does not fully represent the range of the subject under examination (some elements of dataset overweighted or overrepresented, while others left out), or previous data interpretations containing hidden biases in interpretation that reinforce false conclusions, such as biases related to gender, ethnicity or other characteristics, perpetuating discrimination. These biases may also be embedded in the construction of the decision-algorithms applied to the data interpretation.[15]

Lack of transparency and trust

The credibility of AI-generated data and conclusions is strongly dependent on factors that include sources of training materials (these sources can also introduce bias), the precise nature of algorithms applied and the precise wording of questions asked and rubrics set. Consequently, in the development and use of AI applications, there is need to monitor, examine and evaluate each application and not treat AI as an infallible predictive Oracle or unbiased arbiter. The capacity to do this is limited at present by two critical transparency factors: the need for detailed disclosure of sources and methods, and for adoption of open-source practices in the development of AI resources. Many 'open-source' generative AI systems do not actually provide open access to code, while robust and standardised evaluations for LLMs, particularly when dealing with communities that speak or communicate in non-European languages, are seriously lacking.[5]

Detection of personal data

The training and use of LLMs may include the AI application inspecting up to billions of pieces of information 'scraped' from the internet. The natural language processing capabilities of LLMs can be used to identify personal data in unstructured sources such as in texts and to build a profile of an individual—but this may contain erroneous information, misattribution and bias originating with the data source, or be used for purposes of monitoring, tracking and locating. Furthermore, AI can be used to reconstruct linkages between data that has been anonymised or dispersed to protect data privacy, exposing highly sensitive information about individuals and challenging perceptions of what it means to be safe.

Border control and migration status determination

Particularly since the increase of migrants into Europe began around 2015, countries and border control agencies in the region have made extensive use of digital technologies to manage information and support processing of applications. The big data capacities of AI have played an expanding role, including the use of predictive technologies in policy-setting and automated decision making, giving rise to a range of legal, human rights, and ethical concerns, not only with regard to migrants but also in relation to the general population.[16]

marginalised groups (see Panel 3), undermining other efforts to increase fairness in access to healthcare. Other shortcomings, also affecting the general population as well as migrants, include the lack of validation of many applications of AI in healthcare and lack of robust evidence on the use of AI in improving clinical outcomes.

Migration management

Outside the specific field of health, considerable use of AI is already being made in relation to migrants and refugees in EU Member States, including for migration and asylum management as part of broader AI deployment for border and coast guard applications.[4] Problems with sources of data in this fast-moving field have been highlighted and Singleton[21] has called for a complete and updated inventory of data sources and for an evaluation of the quality of data used in EU policy making.

Applications aimed at making services and processing more efficient and strengthening border control management are being deployed, such as digitalisation of application processes, online appointment systems and customer service portals for lodging and tracking applications, as well as for improving information flows between different authorities involved in migration management. Some EU Member States use blockchain technology[4] to enable secure exchanges of sensitive information and to connect different services and systems. AI is also being used for language identification and identity fraud detection.[22]

Lie detectors using AI have been deployed at European borders.[23] Ethical and practical challenges in the use of AI in refugee status determination have been discussed, including in credibility assessments, where the requirement of a 'well-founded fear of being persecuted' involves the bipartite standard of consideration of a claimant's subjective fearfulness and the objective validation of that fear.[24]

It has been questioned whether governments can adopt AI in border security and asylum systems while meeting human rights obligations in these contexts, where states have specific responsibilities toward those seeking refugee and humanitarian protection.[23] Surveillance technologies could increase state monitoring of marginalised communities and lead to human rights infringements—as seen in Greece, where the Ministry of Asylum and Migration was fined by the Hellenic Data Protection Authority in April 2024 for breaching data protection rules in deploying two AI border systems.[25]

There are risks that asylum seekers may be incorrectly returned to their country of origin or an unsafe country and suffer persecution or serious human rights abuse, and use of AI in decision-making raises ethical questions of fairness and due process. Emerging AI principles and safeguards (e.g., human control, transparency, algorithmic impact assessments) building on good governance principles provide opportunities for safeguards, as well as adoption of responsible innovation—involving governments focussing use of AI tools in parts of asylum and related decision-making processes considered less likely to create tension with domestic and international legal principles. The national–regional nexus is a key arena for developing ethical governance systems and policies for AI in asylum contexts.[26]

Intrinsic ethical dilemmas tied to AI's 'dual use' capabilities (see Introduction) challenge humanitarian organisations seeking to harness AI to better support rising numbers of migrants, including refugees and asylum seekers.[27] Oishi et al.[28] described how AI's ability to scrape and analyse big data can predict flows of internally displaced persons and refugees, helping humanitarian aid organisations plan for their needs, including healthcare access. Such tools have been used to register and manage vulnerable populations but, according to Nalbandian,[6] they have not always been applied with sufficient concern for potential data misuse or the ethical and legal foundations of these operations, and are sometimes deliberately used to track and deport undocumented migrants. Beduschi[29] recommends addressing existing risks, such as algorithmic bias and data privacy concerns, as a priority when using AI to shift humanitarian action from reactive to anticipatory approaches. The growing use of biometric data in refugee management without adequate protection exposes individuals to severe harm and may undermine AI's potential health benefits, discussed below.

In the EU context, the Common European Asylum System (CEAS), established in 1999, set out common standards and co-operation "to ensure that asylum seekers are treated equally in an open and fair system". Reform of the CEAS policy was formally adopted by the European Parliament in April 2024, enforcing mandatory asylum proceedings at the external EU border (affecting control practices both adjacent to and within the EU) and introducing an accelerated procedure to speed up the asylum application process, especially in terms of rejecting applications deemed to be unjustified. Concerns about the new rules' impact on refugee rights, which take effect in 2026, are mounting.[30]

Need for caution and legal protection

The combination of opportunities afforded by the expanding capacities of AI (Panel 2) and risks inherent in the use of current AI tools (Panel 3) has led to widespread recognition of the need for regulatory protections and proactive oversight.[31] This has been reinforced by the growing dominance of industry over the three key ingredients of modern AI research: computing power, large datasets, and highly skilled researchers.[5,6,32] In a large collection of multidisciplinary

perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy, a pervasive theme was the lack of legislative and regulatory templates to deal adequately with issues such as privacy, security, accountability, copyright violations, disinformation, misinformation and other forms of abuses and misuses.[6] While new laws were deemed imperative, a critical challenge is that regulators currently cannot penalise deliberate misuse of AI tools—whose global nature demands international coordination to maximise benefits and reduce harm. To address risks and hazards associated with deploying AI in the health sector, Hashiguchi et al.[33] recommended key areas for attention by policy makers which included health data governance, operationalizing AI principles, flexible regulation, digital skills for users, and strategic public investment.

At the time of this writing, there is no global regulation of AI. In an initiative to develop international cooperation on ensuring the safety of AI, the UK government convened a meeting in November 2023 attended by about 30 governments and the EU.[34] This announced an agenda for action focussing on (a) identifying AI safety risks of shared concern, building and sustaining a shared scientific and evidence-based understanding of these risks; and (b) developing respective national policies to ensure safety, including private sector transparency, safety testing tools, and enhanced public sector capacity. Meanwhile, countries worldwide are designing and implementing their own approaches to regulation. The OECD AI Principles guide trustworthy AI development and offer recommendations for national policy and risk frameworks.[35]

On 13 March 2024, the European Parliament adopted the Artificial Intelligence Act (AI Act),[36] which is the world's first comprehensive legal framework for AI. It sets EU-wide rules on data quality, transparency, human oversight, and accountability, addressing general-purpose AI, limits on biometric identification by law enforcement, bans on social scoring and manipulative AI, and the right to consumer complaint and explanation. There was considerable debate and critical comment, both during the evolution and on the final passing of the AI Act, which represents a novel approach at the intersection between technical product safety legislation and legislation intended to protect fundamental rights.[37] Major criticisms of the AI Act focused on its reliance on national market surveillance authorities, which are ill-equipped to protect personal data and human rights issues such as refugee status decisions, and on the need for regulation that is flexible and adaptable to the constantly evolving nature of AI technology.[38]

As detailed in a paper on digital tools for migrant health,[1] blockchain has been an important approach to ensuring the security, confidentiality and portability of personal information, including health records, which are among key concerns for some categories of migrants. In this paper's "AI and the health of migrants" section, we note that combining blockchain and AI heightens security risks. This also illustrates a further point, discussed above, that alongside health applications AI is being extensively used for migration management by many governments, including in the European region. Consequently, AI must be seen as having dual-use capabilities that create ethical dilemmas and require special attention to potential crossover effects that may shift the benefit-risk balance for some migrants and refugees. "Dual use" concerns in AI have arisen in relation to the potential for its applications in medical research (e.g., for drug design) to be misused, especially in the military context (e.g., to develop warfare agents).[39] However, the potential for unintended harmful applications of AI tools to be misused or maliciously repurposed goes far beyond the biomedical area. Larsen and Küspert[40] have commented that "the European Parliament has acknowledged that the speed of technological progress around general-purpose AI models is faster and more unpredictable than anticipated by policymakers" and that the EU "is often seen as a frontrunner in AI regulation, setting the regulatory tone for fostering trustworthy AI globally". The European Commission (EC) emphasises that these models are "becoming too important for the economy and society not to be regulated" and that "powerful AI models could cause serious accidents, propagate harmful biases at scale or, reflecting a dual-use nature, be misused for cybercrime".

Methods

Relevant literature was identified as set out in "search strategy and selection criteria". From the initial literature search, about 100 papers were selected as potentially relevant to the theme of this Personal View and sorted into topics from which the first draft was produced with a provisional structure and text. This was then extensively edited and added to by the co-authors and the text of summaries and conclusions in each section refined and updated. Since the fields of digital health and AI are developing rapidly, priority was given to papers from the last 5 years in general and, in particular, to the most recent ones found, in the selection for inclusion and to the weight given to their significance. Where available, review articles and multiple numbers of papers covering a topic and reaching similar conclusions were given attention as likely to provide reproducibility in an area that is moving very rapidly, while new results of significance were also flagged.

During the TLRHE's review process, the opportunity was taken to update the references cited in the paper and to include newly-appearing literature considered significant.

AI and the health of the general population

Potential health benefits

AI is finding increasing applications in a wide spectrum of health-related areas (Panel 4).

The development of AI tools for this burgeoning list of applications of AI in health is dominated by industry, with the global AI in healthcare market predicted to expand from US$ 15.1 billion in 2022 at a compound annual growth rate of over 37% to more than US$ 350 billion by 2032.[47] Alongside increased applications, a growing body of literature highlights successes in testing environments and expanding use in practice, emphasising their potential for large-scale health impacts.[48] While reviews frequently note technical, legal, and ethical challenges to widespread adoption, few report sustainable improvements in patient outcomes.

A joint 2020 report[49] by the European Institute of Innovation and Technology and McKinsey & Company identified Europe's strong potential to benefit from its extensive national health data, numerous research studies, innovation clusters, and pan-European collaborations. It also emphasised Europe's unified approach to core AI issues such as ethics, privacy, and trustworthy AI, along with its emerging strategy to deliver these advantages across the population. However, the report also noted that valuable datasets are not linked, with critical data-governance, access and security issues needing clarification, delaying further adoption. These challenges, together with the fragmentation observed at the country or regional level, meant that AI's full potential remained to be explored and the impact on the ground remained limited. Observing that the scale of

Panel 4: **AI applications in healthcare, medicine, and public health.**

General scope

AI has the potential to contribute toward the goals of making healthcare more personalised, predictive, preventative, and interactive and extending the effectiveness of public health. A scoping review and framework for uses of AI in health governance has been presented, which highlighted potential for AI to supporting key dimensions of health, including social determinants of health, elements of governance, and health system tasks and goals.[41] Potential benefits to diverse aspects of health may derive from a wide spectrum of AI applications, as illustrated by the following list, which provides a snapshot of the constantly growing range of examples.

Health services: patients, providers, process

Examples include:[42,43]

- Health policy-making
- Universal Health Coverage (UHC) and health financing
- Healthcare organisation, management, planning, delivery, recording
- Health information management and maintenance of patient health records
- Language translations for patients with language barriers and complex medical needs
- Patient empowerment

Medicine

Examples include:[44,45]

- Drug discovery and health research
- Disease prediction/prevention/diagnosis/treatment, including in:
  - Non-communicable diseases, including cancer
  - Gastroenterology and hepatology
  - Diseases which some ethnic groups may be particularly at risk of contracting
- Strengthening delivery of health services/treatments, including in mental health and psychiatry
- Personalised medicine, e.g., selecting drugs to attune with patients' genetic, clinical, and lifestyle characteristics
- Precision medicine, e.g., identifying phenotypes of patients with less-common responses to treatment or unique healthcare needs

Public health

Examples include:[46]

- Disease modelling
- Health emergencies
- Better health and well-being (including prevention of noncommunicable disease, promoting mental health, minimising and eradicating high-impact communicable disease and addressing the health effects of climate change)
- Predicting disease outbreaks
- Health information retrieval, exchange, translation
- Public health information, advice
- Specialist information for health workers
- Community/voluntary sector organisations working with vulnerable groups, such as asylum-seekers and refugees

many solutions remained small, the report described three phases of scaling AI in healthcare. In the first, solutions are likely to address the low-hanging fruit of routine, repetitive, and largely administrative tasks, optimising healthcare. In the second, more AI solutions were expected to support the shift from hospital-based to home-based care, including remote monitoring, AI-powered alerting systems, and virtual assistants, along with expanded use in specialities such as oncology, cardiology, and neurology. This would require deeper integration into clinical workflows and strong engagement from professional bodies and providers. It also calls for well-designed, integrated solutions to apply existing technologies effectively in new contexts. Scaling up would be driven by both technological advancement and cultural and organisational capacity building. In the third phase, more AI tools would be used in clinical practice based on trial evidence, with increased focus on advanced clinical decision-support systems. A key challenge is building clinical evidence of quality and effectiveness in an environment where start-ups seek to scale quickly, while healthcare professionals require proof of safety and efficacy. The report recommended transparency and collaboration between innovators and practitioners as essential to scaling AI in European healthcare.

Despite the continuing expansion in the market and the increasing adoption of AI tools since the 2020 report, the scaling of AI in healthcare appears largely confined to phases 1 and 2 and has yet to demonstrate clear benefits in patient outcomes at scale. Reviewing AI in medicine in 2020, Briganti and Le Moine[50] considered that one of the core challenges to come in the next years will be the clinical validation of the core concepts and tools recently developed. They noted that, while many studies had shown AI's potential and promising results, several well-recognised and frequently reported limitations in these studies are likely to complicate clinical validation. Three key limitations identified were that the majority of studies comparing AI and clinician efficiency suffered from unreliable study designs; studies reporting AI applications in clinical practice were often limited by retrospective approaches and small sample sizes; and only a few studies have directly compared AI and clinicians using the same datasets. In a further review of the field in 2023, Krishnan et al.[51] documented an expanding array of new applications and the potential for the integration of AI in healthcare to offer significant advantages over traditional medical practice. However, they also drew attention to inherent limitations in the capacities of current AI tools. Among these, Krishnan et al. highlighted that the limited generalisability of AI models trained on specific datasets may hinder their transferability to different patient populations or geographic regions, limiting their overall applicability in diverse healthcare settings. In a 2024 editorial, Schlieter et al.[52] noted that the scale-up of digital health technologies remained challenging and has not yet been sufficiently addressed, with the quantification of implementation outcomes remaining unclear. A study[53] on AI implementation in Swedish healthcare emphasised the need for coordinated strategies, supportive laws and policies, and investment in capacity building, with collaboration among healthcare organisations, county councils, and industry partners.

In a 2022 overview of systematic reviews on AI's impact in UHC, health emergencies, and health promotion, Martinez-Millana et al.[54] found that AI applications in UHC were mainly focused on image analysis for neoplasms, followed by mental and behavioural disorders, circulatory, and musculoskeletal diseases. There was an emphasis on prediction and detection of the diseases, while some reviews focused on the classification of degrees and severity scales for diseases. Notably, 52% of the reviews did not report any validation procedure and, regarding quality assessment, 61% did not implement any method for analysing the risk of bias. For areas related to health emergencies protection, the reviewed applications of AI mainly focused on infectious or parasitic diseases. The overview noted that, to date, a limited level of maturity of AI use in clinical practice had been achieved and in many areas there was an absence of reported studies on the real impact of the AI tools in clinical settings. Common issues identified included the lack of standardisation of protocol designs and heterogeneity of software infrastructures used to collect, store, and analyse personal and clinical data. Nevertheless, many of the reviews in the study were optimistic about the important role AI can play in improving diagnosis, treatment and outcomes. Martinez-Millana et al. did not discuss patient perspectives in their analysis.

In a 2022 review, Rajpurkar et al.[55] presented key findings from a two-year program tracking advances in medical AI, including prospective studies, medical image analysis, and novel research avenues such as non-image data and human–AI collaboration. They also noted that, although AI systems had repeatedly been shown to be successful in a wide variety of retrospective medical studies, relatively few AI tools had yet been translated into medical practice. They pointed to weaknesses in the often-limited datasets used for regulatory clearances and commented that, to build trust in medical AI systems, stronger standards for reporting transparency and validation will be required, including demonstrations of impact on clinical outcomes. Among the areas that had advanced furthest in recent years,

deep learning, in which neural networks learn patterns directly from raw data, had achieved remarkable success in image classification. This had greatly benefitted specialities that rely heavily on the interpretation of images, such as radiology, pathology, gastroenterology and ophthalmology. AI had also achieved considerable improvements in accuracy for radiology tasks, including mammography interpretation, cardiac function assessment and lung cancer screening, contributing to diagnosis, risk prediction and treatment. In pathology, AI had made major strides in diagnosing cancers and providing new disease insights, largely through the use of whole-slide imaging. In the field of information and education, the language processing capacities of AI were being seen in tasks like answering biomedical questions and mining social media to track large-scale mental health trends. Rajpurkar et al.[55] also noted that multiple studies have shown that clinical experts and AI in combination achieve better performance on many tasks than experts alone. More recent publications have reinforced this view, advocating for combining clinical experts with AI to advance AI adoption in medicine, emphasising the need to validate AI performance across diverse clinical settings,[56] and calling for clearer regulatory guidance on using LLMs to generate clinical summaries.[57]

In the first examination of the impact of a deep-learning tool in real clinical settings, a study from Google Health showed that even the most accurate AIs can actually make things worse if not tailored to the clinical environments in which they will work.[58] An independent evaluation of a widely used prediction model in US hospitals during the COVID-19 pandemic found it identified small subsets of high- and low-risk patients with good discrimination, but its clinical use as an early warning system was limited by low sensitivity.[59] In another external validation,[60] an AI algorithm commonly used in US hospitals to assist clinicians with missed sepsis cases showed poor calibration and discrimination in predicting sepsis onset and caused significant alert fatigue when tested in a hospital system without prior training data.

Challenges, problems, and risks

Alongside the increasing range of application of AI in health, there is also a growing body of concerns about dangers associated with the uses of AI in health. These concerns (Panel 5) reflect the themes of emerging risks and deficiencies in the underlying characteristics of AI at its current stage of development and in the general potentials for misuse and abuse of AI summarised in Panel 3.

The issue of bias in the use of AI, discussed in Panel 5, has become particularly acute with the increasing incorporation of generative AI into digital tools for health[76] and employment of demographic shortcuts in disease classification,[77] reinforcing the need for extreme care in the applications of AI tools for the health of migrants discussed in the next section.

Applications of XAI techniques in healthcare have been steadily growing. A systematic review[78] of various XAI methods in medicine found variability in ease of use and performance aspects such as reliability assessment. It also highlighted a lack of reliable, automated solutions that provide convincing explanations for medical experts during decision-making, and a need for more detailed criteria to evaluate and compare XAI methods in diagnosis detection. Another review by Hulsen[79] raised concerns about privacy and security risks, as explanations for AI decisions may expose sensitive data or enable system manipulation, such as through reverse engineering. Hulsen also questioned whether explanations always increase trust, noted a trade-off between explainability and accuracy, and pointed to alternative approaches like "Explainability-by-Design", a method that incorporates explainability from the start rather than adding it later as a reactive measure.[80]

Artificial Intelligence and the health of migrants

Digital tools in general offer numerous opportunities with the potential to help support the health of migrants and facilitate research on their health issues.[1] At the same time, these tools pose potential risks to migrants, including threats to the freedom of undocumented individuals; concerns over information security and confidentiality; challenges with informed consent; the involvement of migrants in designing and researching digital tools; access to mobile phones and the internet along with associated user costs; and access to health services for follow-up care. The need for a socio-technical perspective was emphasised and a model presented that combine three complementary dimensions of structural factors, health determinants and human security.[1]

It is well established that undocumented individuals largely avoid health systems due to fear of detention and deportation, as well as facing policy, administrative, and practical barriers when they do seek care.[81] A 2024 review of the literature on access to healthcare for undocumented migrants in the WHO European Region called for urgent action towards ensuring UHC for all migrants regardless of immigration status by 2030.[82] Meanwhile, the question remains whether digital solutions, including those incorporating AI, can assist in meeting the health needs of undocumented migrants. As has been emphasised, digital tools provide technical solutions and may be able to help, but they do not necessarily overcome problems that are political, social, or economic in nature[1] and may, on the other hand, worsen the risks. The implications for breaches in data

Panel 5: **Concerns associated with the uses of AI in health.**

Fictitious data

Examples of 'hallucinatory' or invented material generated by AI chatbots have been reported in the health field and concerns expressed about the implications for medical training, research, patient diagnosis and treatment.[61]

Spreading misinformation and disinformation

There is growing evidence of, and concern about, the occurrence of misinformation and disinformation in the health field and of an "infodemic" of high levels of distrust in health information and public health measures as a consequence.[62] In specific fields, reports have included impacts of AI misinformation in causing deaths from COVID-19 among unvaccinated people,[63] setting back pandemic preparedness,[64] dissuading cancer patients from accepting treatments proven to be effective,[65] encouraging uptake of unproven alternative therapies,[66] and providing dangerous advice about mental illness.[67] The UN Under-Secretary-General for Global Communications has highlighted challenges and opportunities of AI in disseminating accurate global public health communication, particularly in the areas of vaccines, climate change, and well-being of women and girls.[68] A combination of approaches to limiting the impact of misinformation and disinformation in health has been advanced, including detection using AI-based techniques.[69]

Bias

Evidence indicates that algorithms used in decision-making may lack 'fairness',[31] which may lead to inequitable outcomes across racial and socio-economic groups, including in the health field. Wang et al.[70] have presented a bias evaluation checklist that enables model developers and health care providers to systematically appraise a model's potential to introduce bias. Four categories of biases have been observed as particular to the uses of AI in healthcare, relating to unfairness linked to model design, training data, and AI interactions with clinicians and with patients[70,71] Giovanola and Tiribelli have argued for the adoption of fairness as an ethics principle in AI for healthcare, with implications including the need to design compensatory tools that help to promote real chances for every person to enjoy equally the resources and facilities of the digital health ecosystem.[72] Other kinds of bias in relation to AI-based decision-making may arise from systematic methodological flaws in the ML literature for diagnosis and prognosis models using imaging data; and the fact that AI systems rely on forms of reductive reasoning and computational determinism, which may embed problematic assumptions about clinical decision-making and clinical practice. In the case of colorectal cancer, a number of problems in the employment of AI were observed, including inherent biases in retrospective training datasets and embedded assumptions in underlying AI architectures and algorithms, in the limited evaluations conducted on AI systems prior to their integration into clinical practice, and in the marginalising of socio-technical factors in the context-dependent interactions between clinicians, their patients, and the broader health system.[73] Chin et al.[74] have developed some guiding principles to address the impact of algorithm bias on racial and ethnic disparities in health and health care, relevant to preventing worse outcomes for racial and ethnic minoritized groups and other historically marginalised populations.

Lack of transparency and trust

Given the myriad challenges faced by vulnerable individuals within migrant groups, there is often a trust deficit between them and healthcare providers. Lack of familiarity with technology further fuels this mistrust. Studies have shown that some social factors, including membership of historically marginalised communities, may lead to a higher level of mistrust in AI in healthcare applications.[75]

Data security, privacy, and detection/misuse of personal data

It is vital to maintain the confidentiality of medical records in order to protect the privacy and security of the individual. However, because health records are important and vulnerable, hackers often target them. The vulnerability to breaches in data security is compounded by the lack of standard guidelines for ethical use of AI in healthcare.

Ethics

The wide-ranging capacities of AI-assisted digital tools to acquire, analyse, interpret and report on large data sets has many implications for the privacy, confidentiality, accuracy and security of information of individuals, with potential for use and misuse. Ethical approaches require that all of these potentials are carefully evaluated to protect the rights of the individual while seeking to optimise their health benefit.

security can be particularly severe for migrants who do not have regular status or documentation. For example, it may jeopardise their attempts to obtain refugee status or increase their risk of deportation. In small closely-knit communities, data breaches could result in loss of privacy and in stigma. Blockchain is a key technology that enables portability of data while ensuring a high degree of security and privacy. Blockchain is a shared, immutable ledger that facilitates the process of recording information, which is contained in a distributed database that maintains a continuously growing list of ordered records, called blocks, which are linked using cryptography. The blockchain properties of security, confidentiality and interoperability are extremely valuable in many settings, including in maintaining health records confidentially and in the provision of secure digital identity information on people in humanitarian settings.[1] In recent years, AI technologies have been increasingly integrated into blockchain applications, helping to solve challenges related to blockchain scaleup, speed and interoperability while blockchain enhances the security of AI tools. The combination is finding a variety of applications in healthcare.[83] However, several challenges have been

identified in using AI-powered blockchain for health, including issues concerning privacy, blockchain security and threats, and lack of standards, interoperability, and regulations.[84]

The increasing incorporation of AI within many of the digital tools being used in relation to migrants has created a step-change, both in the potential value of the tools and in the risks associated with their use. For example, documented applications of ChatGPT used to help refugees include language support, community engagement, increasing productivity to enhance employability, and legal assistance.[85] Some countries, including the UK, are using AI to accelerate asylum application processing, while a Council of Europe report on blockchain identified legal challenges related to protecting anonymity and privacy rights, as well as conflicts between law and jurisdiction arising from blockchain's distributed, global nature.[86] The report concluded that it was essential for the Council of Europe to develop a research and policy agenda that allows it to be fully aware of the opportunities and risks presented by blockchain.

Migrants are frequently the subject of misinformation and disinformation. A literature review[87] on asylum seekers highlighted the need for a nuanced understanding of how they are disadvantaged, noting various forms of misinformation, including outdated or poorly presented official information, misinformation from gatekeepers, false hopes, rumours, and distortions. A Social Information Perception model and the concepts of perceived and normative misinformation were proposed to better understand the information practices of vulnerable groups and support the delivery of trustworthy, culturally meaningful information. AI has been used to counter misinformation about migrants by detecting bot-like social media activity,[88] analysing text,[89] and providing factual chatbot dialogues.[90]

Objectives for using AI-based tools vary across policymakers, officials, service providers, and migrants, often leading to competing interests, unintended consequences, and negative impacts. Fundamental flaws in current AI systems, such as surveillance concerns, systemic bias, and the spread of misinformation, undermine trust and raise concerns about potential human rights violations.[91] These issues are particularly serious for marginalised groups like migrants. It is important to adopt a cautious and critical approach to AI's role in healthcare for these populations. While AI holds promise, it should serve as a complement to, not a replacement for, existing healthcare interventions.

Potential health benefits

AI offers opportunities to improve health communication, overcome language barriers, enable faster expert diagnosis and treatment, and support case management for mobile and vulnerable populations. The extent to which migrants take up these opportunities depends on personal and societal factors that shape access and influence individual perceptions of risk and benefit.

Machine learning methods have been used to examine whether the immigrant health advantage, especially among documented migrants, also applies to undocumented immigrants in the USA by imputing missing legal status data from the National Health Interview Survey. The study concluded that the undocumented population experienced a more pronounced Healthy Migrant Effect.[92] AI-based digital tools have been used to help diagnose health conditions and assess communicable disease prevalence among refugees by analysing disease-related references on social media.[93]

Digital health applications show promise for immigrant and refugee mental health care but relatively few have been thoroughly validated to date.[94] Jahani et al.[85] cited several digital programs with AI potential including mental health resources, platforms for medical staff to better understand migrant cultures, and AI-driven therapy to help migrants cope with difficult situations. They emphasise the importance of strong security and privacy measures such as blockchain technology to protect sensitive information as well as the need for validation of outcomes and training datasets that reflect refugees' specific needs and experiences to improve reliability. They also highlight the necessity for chatbots to develop a specific understanding of users' conditions to provide adequate mental health support for refugees. The Retrieval-Augmented Generation technique, which combines chatbot language models with external knowledge retrieval, can help generate responses that are both factually accurate and contextually relevant.[85] Additionally, the use of digital twins to simulate health challenges and appropriate care scenarios may further enhance health outcomes for migrant populations.[95]

Chatbots can help meet the healthcare needs of migrant workers by improving access to health information, enhancing health literacy, and reducing loneliness, as demonstrated with refugee women in the UK.[96] A study[97] on chatbot applications for migrant workers in Taiwan offered five design recommendations: (1) use multimedia, such as infographics, to simplify health information and multimodal interactions like voice commands to make chatbot use more natural and inclusive; (2) ensure interactions are simple to facilitate queries with minimal prior knowledge; (3) provide referrals to face-to-face human services when migrant workers need additional support; (4) design chatbots as closed-domain systems to guarantee health information comes from reliable sources; and (5) embed chatbots in instant messaging apps frequently used by migrant workers to encourage consistent use for seeking healthcare, obtaining information, and communicating with health professionals.

Summarising the information presented in detail above, Table 1 compares the challenges and risks of

AI challenges and risks	General population	Migrants
Access to technology	The general population faces disparities in access to digital health technologies, particularly in low-income areas and remote or rural locations.[1]	Migrants may encounter more significant barriers, such as financial constraints and limited access to infrastructure.[1] In addition, there are sometimes gender issues within the family or community which restrict or prevent access for women and girls.[98]
Language barriers	The general population may encounter technical language challenges if understanding of the AI terminology and processes is important for risk assessment or informed consent.	Migrants may also face additional obstacles in accessing technology in their native languages, in understanding how the use of AI may present security risks and in being able to give or withhold informed consent freely.
Fictitious data	Examples of 'hallucinatory' or invented material generated by AI chatbots have been reported in the health field and concerns expressed about the implications for medical training, research, patient diagnosis, and treatment.[61]	Migrant groups may be mis-characterised as a result of hallucinatory AI results, or individually mis-identified.
Bias and discrimination	Evidence indicates that algorithms used in decision-making may lack 'fairness',[31,70] which may lead to inequitable outcomes across racial and socio-economic groups, including in the health field. Categories of biases observed in uses of AI in healthcare relate to unfairness linked to model design, training data, and AI interactions with clinicians and with patients,[15,71] as well as systematic methodological flaws in the ML literature for diagnosis and prognosis models using imaging data; and the fact that AI systems rely on forms of reductive reasoning and computational determinism, which may embed problematic assumptions about clinical decision-making and clinical practice.[73]	Marginalised groups face AI bias, and for migrants, the risk is even higher in immigration systems where AI can perpetuate harmful biases. Lack of data on the health of migrants leads to the risk of bias in AI systems dealing with their health: coverage of migrant data is incomplete and of insufficient quality in European health information systems.[71] Migrants are vulnerable to types of bias found in a study[76] of GPT-4, which showed significant biases in potential applications of LLMs in the clinical domain (medical education, diagnostic reasoning, clinical plan generation, and subjective patient assessment). They may also be vulnerable to biases which result from demographic shortcuts leveraged by medical imaging AI in disease classification introducing potential for bias and unfairness in real-world settings.[77] The marginalising of socio-technical factors in the context-dependent interactions between clinicians, their patients, and the broader health system[73] is likely to disproportionately impact on migrants.
Spreading misinformation and disinformation	There is general concern about the occurrence of misinformation and disinformation in the health field.[62]	Migrants are often the subject of misinformation and disinformation.[87] Various types of misinformation are encountered by asylum seekers,[87] including official information that is inadequate or presented inadequately, outdated information, misinformation via gatekeepers and other mediators.
Lack of transparency and trust	Misinformation, disinformation, and AI- generated fictitious data can create distrust in health information and public health measures.	There is often a trust deficit faced by vulnerable individuals within migrant groups, which may be deepened by lack of familiarity with technology. Social factors, e.g. membership of historically marginalised communities, may lead to a higher level of mistrust in AI in healthcare applications.[75] Migrants are more likely to be subjected to technology-enabled surveillance and the potentials for systemic bias in AI decision-making and for the dissemination of misinformation. This limits confidence on all sides about the reliability and security of using AI-based approaches and raises concerns about the potential for human rights to be eroded.[26]
Data security, privacy, detection/misuse of personal data, and discrimination	To protect the privacy and security of the individual, maintaining the confidentiality of medical records is essential and they may be targeted by hackers.[99] Vulnerability to breaches in data security is compounded by the lack of standard guidelines for ethical use of AI in healthcare.	Migrants face increased risks from profiling and misuse of personal data due to the sensitivity of their immigration and health data. Undocumented individuals largely avoid using health systems because they fear detention and deportation.[75] Data breaches could result in loss of privacy and in stigma.
Legal and policy issues	There is a general lack of effective regulation of AI, which impacts all users.	Migrants, particularly asylum seekers and refugees, face disproportionate consequences, particularly in the context of immigration enforcement.
Economic impact and job displacement due to automation	AI automation threatens the livelihoods of low-skilled workers in general.	Migrants are disproportionately represented in low-paid and insecure work and may be particularly vulnerable to job losses.
Ethics	The wide-ranging capacities of AI-assisted digital tools has many implications for the privacy, confidentiality, accuracy, and security of information of individuals, with potential for use and misuse.[26] Ethical approaches require that all of these potentials are carefully evaluated to protect the rights of the individual while seeking to optimise their health benefit.	Ethical challenges include threats to the freedom of those migrants who do not have regular status; the security and confidentiality of information; informed consent; engagement of migrants themselves in designing, implementing and researching digital tools; access to mobile telephony and internet and the costs for the user; and access to health services for follow-up.

Table 1: **AI challenges and risks for health for the general population and for migrants.**

using AI for the health for the general population and for migrants.

Opportunities, risks, and challenges for the European region

The rapid growth of AI applications in health has been likened[100] to a largely unregulated 'Wild West' frontier, with fast development, unproven claims, and a lack of global standards, raising concerns about quality, patient safety, ethics, equity, and inclusion for vulnerable groups. The challenges have been acknowledged by different actors but, as noted by Denniston and Liu,[101] recognising the problem is easier than describing a solution.

At the regional level, Europe has significant potential to develop common cross-border standards, regulatory frameworks, and best practices for AI applications in health, while safeguarding the rights of individuals and groups. A variety of European institutions contribute to shaping important components, including the WHO Regional Office for Europe (WHO-EURO) and European Observatory on Health Systems and Policies, European Commission, Parliament and Union, Council of Europe, and European Free Trade Association. While the geographical coverages vary (e.g., EFTA has 4 member countries, EU 27, Council of Europe 46, and WHO-EURO 53), many policies, standards and practices are mutually aligned to support cross-border trade, services and movements of people, skills and data. A key pillar of the European Health Union is the ambition to create a common European Health Data Space (EHDS), aiming to foster a single market for electronic health records and provide a consistent, trustworthy, and efficient system for reusing health data in research, innovation, policy-making, and regulation, which is directly relevant to AI, health, and migrants.[102]

The EU has taken a major step in the regulation of AI through establishing the most comprehensive AI regulatory framework globally to date. The primary objective of the EU AI Act,[103] which came into force in 2024, is to ensure AI systems are developed and used in a manner that is safe, transparent, and respects fundamental rights. A key aspect is the adoption of risk-based assessment, in which AI systems are classified into four risk categories as minimal, limited, high, and unacceptable. This has important health implications, especially for migrants, with high-risk AI use cases such as biometric categorisation, healthcare eligibility determination, and emergency patient triage.[104]

Early critiques of the 2024 EU AI Act concerning AI in healthcare highlight ambiguous wording in many parts, with broad objectives that will require further detailed guidance, standards, and member state laws, alongside uncertainty about how the Act will interact with existing sector-specific legislation for medical AI.[105] An analysis by van Kolfschooten and van Oirschot[106] concluded that the AI Act insufficiently addresses the interests of patients and requires sector-specific guidelines in the healthcare sector. Schmidt et al.[107] having mapped the regulatory landscape for AI in health in the EU, highlighted that future work should explore specific regulatory challenges, especially with respect to AI medical devices, data protection, and data enablement. Salaiman and Malik[108] have also drawn attention to flaws in the Act's risk-based approach, with private entities potentially empowered at the expense of patient autonomy.

Specifically in relation to migrants, arguments have been made that the Act does not sufficiently safeguard their fundamental rights, as it includes exceptions for large-scale migration databases, where regulations will only come into effect in 2030, and establishes a separate legal framework for the use of AI by law enforcement, migration control, and national security authorities, creating unjustified loopholes and potentially encouraging the use of harmful systems for discriminatory surveillance of the most marginalised in society.[109,110]

A particular aspect of bias arises from the use of data that is not fully inclusive of the diversity in the population, uses historically skewed data as the basis for proxies or approximations, or fails to recognise biological diversity. For example, a model study[76] evaluated whether GPT-4 encodes racial and gender biases and examined the impact of such biases on four potential applications of LLMs in the clinical domain (medical education, diagnostic reasoning, clinical plan generation, and subjective patient assessment). The study found that GPT-4 exhibited significant biases across all areas, underscoring the urgent need for thorough and transparent bias assessments of LLM tools like GPT-4 before they are used in clinical care. A study[77] in three key medical imaging disciplines (radiology, dermatology, and ophthalmology) incorporating data from six global chest X-ray datasets (four from the USA, one each from Spain and Vietnam), revealed that medical imaging AI leveraged demographic shortcuts in disease classification, introducing potential for bias and unfairness in real-world settings.

Other research has emphasised the need to consider gender in the development of AI tools for health and to centre disability in technology policy, particularly in relation to health, to avoid discrimination.[111,112] Some diagnostic algorithms are built to modify their suggestions based on a patient's race or ethnicity to establish a risk assessment profile and guide clinical decisions.[113] Risks of algorithmic discrimination are pervasive and multifaceted, as recognised in the 2020 White Paper on AI from the EC which identified that increasing use of algorithms in Europe posed specific risks to fundamental rights protection, especially in relation to equality and non-discrimination.[114]

A 2022 publication[115] on algorithmic discrimination in health care examined from social, legal, and

technological perspectives whether the EU's then-current anti-discrimination legal framework offered adequate protection to patients who face automated discrimination. The study concluded that, although the European Court of Justice has affirmed non-discrimination as a general principle of EU law, existing EU anti-discrimination laws are poorly equipped to address algorithmic bias, highlighting an urgent need for reform, particularly in healthcare and within secondary legislation such as directives and regulations. A comprehensive review[116] of ethical considerations in the use of AI and ML in health care, published in 2024, noted that ethical considerations permeate every aspect of the development, implementation, and utilisation of AI and ML in health care. The review emphasised the need to critically evaluate each case and to foster a culture of ethical awareness and accountability among healthcare professionals, policymakers, technology developers, and patients.

Limited data on migrant health increases the risk of bias in AI systems addressing their care. Bozorgmehr et al.[117] note that migrant data in European health systems is often incomplete and low quality, mainly due to political barriers at various levels that hinder the use of existing knowledge and guidelines. Including such data could greatly benefit public health programs. To be of value, they argue that the data needs to be disaggregated in relation to meaningful core categories that reflect the diversity of migrants in different and evolving situations with different migration trajectories. Acknowledging the risks regarding the anonymity of those migrants who are in vulnerable situations and fear identification and deportation, as well as regarding the political challenges and risks of including sensitive data on migration in health information systems, Bozorgmehr et al.[117] emphasised the need for strong laws to protect the health data of those who are vulnerable or in fear of deportation from being used inappropriately (e.g., for immigration enforcement) while allowing access for researchers and practitioners and with possibilities for data linkage using privacy-preserving record linkage. To bridge the gap between current realities and intended goals, they proposed four key strategies: ensuring systematic collection, analysis, and sharing of data; developing methods to safeguard privacy when combining data from multiple sources; adapting survey methods to account for the diversity of migrant groups; and actively involving migrants in decisions about how their health data is used. This last point is also of importance in relation to research, which is discussed in the section below.

Research

While applications of digital technologies generally have been expanding rapidly in the health field, research focused on AI applied to the health of migrants has so far been limited. The following summarises types of studies published to date, highlighting conclusions and recommendations for further research.

AI-based diagnostic tools

In the health field, one of the most advanced applications of AI has been computer-aided detection (CAD) software for disease diagnosis, which uses deep learning to identify and analyse patterns in medical imaging, such as scans, as well as in patient-related data.[46] While, in principle, these applications are relevant to migrants in, or intending to come, to Europe, several concerns have been raised in studies of such use, including issues relating to local capacities, ethics and privacy.

Tuberculosis (TB) has received significant attention in migration contexts because it mainly affects low- and middle-income countries, which account for over 80% of cases and deaths globally. Many destination countries require negative chest radiograph or sputum tests before allowing entry or travel from specified countries. The European Centre for Disease Prevention and Control (ECDC) recommends active TB screening soon after arrival for migrants from high-incidence countries, referring those with abnormal chest X-rays for further assessment.[118] Due to inconsistent policies and follow-up across the EU and EFTA, the European multi-country consortium E-DETECT TB was created to evaluate the effectiveness of migrant TB screening and subsequent care.[119]

Use of AI-based CAD for detection of TB and research on this application, both in the general population and in migrants, is summarised in Panel 6. This illustrates many important aspects of the evolving use of AI-based tools in clinical diagnosis, including the rapid adoption of new applications, limited research on their effectiveness in real-world settings beyond initial validation studies, insufficient involvement of relevant migrant groups in design, implementation, or research stages, and ongoing concerns about ethical and privacy issues. Several studies have drawn attention to the need for more research to fill these gaps.

AI-based applications in mental health

Migrants, particularly refugees and asylum seekers, face a high risk of mental illness, yet their access to mental health care services in host countries is frequently limited by various barriers. Digital solutions aiming to help fill this gap have become increasingly widely available, but often with little assessment of effectiveness.[1]

In a critical analysis of the literature (2010–2023) on the use of digital mental health interventions for the management and treatment of mental health disorders among refugees and asylum seekers, ten articles were selected.[126] The study showed that the use of the digital interventions was associated with positive experiences among refugees and asylum seekers. None of the ten papers examined made reference to the use of AI in the

***Panel 6*: AI in computer automated detection of tuberculosis, including in migrants**

A rapid expansion has been seen in the number of AI-based CAD products available on the market for detecting TB-related abnormalities from chest X-rays (CXR) and for identifying drug-resistant TB, and evidence has been presented that deep learning systems can perform at least as well as trained radiologists in active pulmonary TB detection.[120]

It has been emphasised that the evaluation of the use of these products in TB programmes needs to consider not only their diagnostic accuracy but also implementation-relevant features including operational characteristics, deployment mechanism, input and machine compatibility, output format, options for integration into the legacy system, costs, data sharing and privacy aspects, and certification, as well as regulations adapted to address health equity issues.[121] In view of requirements for pre-migration testing for TB, circumstances of testing in potential migration source countries are relevant to migration into Europe.

WHO recommends the use of CAD for interpreting CXR to triage and screen for tuberculosis in people aged 15 years and older.[122] A compilation of early user experiences from nine high TB-burden countries focused on practical considerations and best practices related to deployment, threshold and use case selection, and scale-up.[123] It was noted that, In the absence of clear guidance, strategies for threshold selection were diverse and unstructured. Where practical, it was recommended that CAD software be deployed in parallel to human readers for a short duration, with sputum is collected for any abnormal CXR interpretation, including instances where the radiologist and CAD software have discordant results, permitting thresholds to be optimised in a 'reality-based' manner. Current challenges in most high TB-burden countries were noted to stem primarily from the absence of a nationally standardised unique citizen identifier, inconsistent data structures in comparison to legacy systems, and inadequate IT infrastructure, particularly in peripheral settings, as well as issues of equity of access and utility for persons affected by TB. Noting the explosive growth of AI in the healthcare setting, and in particular in the case of CAD software for TB screening, the necessity for increased frequency of updating policies and guidelines (which historically has usually been done on a lifecycle of 3–5 years) as well as for a reliable, open-source evaluation dataset to benchmark CAD software performance, was highlighted by the study.

One of the first comprehensive studies evaluating CAD systems independent of the CAD developer, in a population screened for TB using both culture results and expert radiologist assessments as reference standards, was reported in 2023 by Gelaw et al.[124] The study examined the diagnostic accuracy of three AI-based CAD systems (CAD4TB, Lunit, qXR) for detecting pulmonary tuberculosis (TB) in global migrants screening CXR cases, when compared against both microbiological and radiological reference standards (MRS and RadRS, respectively). The study demonstrated that the three CAD systems had broadly similar diagnostic accuracy with regard to TB screening and comparable accuracy to an expert radiologist against MRS. Lunit performed better than both qXR and CAD4TB against MRS, and CAD4TB and Lunit better than qXR against RadRS. However, none of the CAD systems reached the minimum performance requirements of the WHO triage standard (90% sensitivity and 70% specificity). Moreover, Gelaw et al. noted that the performance of the CADs can be impacted by characteristics of subgroup of population, including age, gender, presence or absence of TB symptoms, HIV-positive status, and status as an 'immigrant' compared with those classified with a 'refugee' status.

A study published in 2024 evaluated 12 CAD products used with participants from a South African tuberculosis prevalence survey, in which the primary outcome was comparing the accuracy of products against microbiological evidence.[125] The study reported wide variations in sensitivity, specificity and threshold level for TB detection. The products evaluated showed similar subgroup bias, universally performing worse in individuals aged 55 years or older than in individuals aged 15–34 years and some also performed worse in those with a history of tuberculosis. It was recommended that implementers such as national tuberculosis programmes seeking to use CAD should use on-site operational research to select the optimal threshold, rather than rely on extrapolating thresholds quoted in literature.

application studied. A systematic review[127] published in 2024 examined the efficacy of technology-based mental health interventions in minimising mental health symptoms among asylum seekers and refugees. The analysis found little evidence that digital interventions such as mobile based therapies, video conferencing and digital platforms significantly reduce depressive and anxiety symptoms among migrants and refugees and no substantial decrease in PTSD symptoms was observed after using a self-help mobile app. There was limited evidence that digital psychological therapies can reduce depression in these groups. Future study with a randomised experimental design is required to examine the effectiveness of digital treatments in lowering the impacts of mental health outcomes among immigrants. The need for further research was emphasised, but uses of AI were not mentioned in the review. As noted earlier, Jahani et al.[85] highlighted the potential of AI assistance, including chatbots, for mental health issues among immigrants and refugees, while emphasising the need for validation of results among other concerns. Abdelrahman has highlighted that smartphone AI apps, designed to help millions of refugees manage mental health symptoms, can also be used for surveillance and border control, as well as for harvesting, storing, and selling information on refugee trauma, turning their experiences of loss, grief, and suffering into quantifiable and marketable commodities.[20]

Using AI to improve refugee integration and social wellbeing

Social determinants are an important factor in contributing to the health and wellbeing of migrants. For example, machine learning and optimisation to

find refugees new homes can significantly improve their chances of finding work within three months.[128]

AI can improve research on the social determinants of health and well-being for migrants by analysing large datasets, identifying patterns, predicting health outcomes, and pinpointing specific migrant groups disproportionately affected by negative social factors. This can ultimately support more targeted interventions and policies. At the individual level, it can assist in overcoming language barriers, building social networks, finding information and support and countering loneliness, isolation and exclusion. Research to examine the extent to which specific AI tools and programmes actually deliver these potential benefits is needed and to date few studies have been published.

An assessment in Greece evaluated how AI integration improved outcomes of mobile apps designed to support integration for immigrants from Europe, Asia, and Africa attending free language classes, regardless of their residence or work permit status.[129] The study found positive effects of 'm-Integration' applications on overall levels of societal integration, health and mental health. The patterns were gender sensitive, with the association between the number of m-Integration applications in use and the reduction of adverse mental health symptoms being stronger for men than for women. This difference possibly reflects the gender disparities in access to and ownership of mobile phones, as well as familiarity with mobile applications within the immigrant population. This illustrates the value of taking an intersectional approach which considers more than a single dimension of identity such as refugee or migrant status, in developing effective digital tools for these population groups. Qualitative research by Islam et al.[130] on digital primary care use among migrants in the UK revealed intersections between migrant status, gender, age, and income, with those in temporary housing especially at risk of exclusion or marginalisation.

Research agendas and guidelines for migrant health

WHO's research agenda on health, migration and displacement provides a roadmap for building responsive health systems that are inclusive of migrants.[131] While not specifically mentioning AI or related terms such as deep or machine learning or big data, the document provides a framework of good practice for research on migrants and health. It emphasised the need for increased research and clear guidelines adapted to various settings, while prioritising global collaboration and the effective translation of evidence into policy and practice. The report also stressed the importance of considering life-course perspectives, examining intergenerational effects of migration and displacement, applying an intersectional lens, and incorporating greater diversity across gender identity, sexual identity, race, and ethnicity. Additionally, it highlighted the value of actively involving migrants, including refugees and other displaced populations, in participatory research approaches to ensure their perspectives are represented.

MacFarlane et al.[132] have called for a "paradigm shift in the field of refugee and migrant health" in the WHO European region to make participatory health research routine or normalised. A continuum of approaches to participatory health research has been developed.[133]

Research in humanitarian contexts

Ethical, political, and institutional concerns have arisen from the rapid and often uncritical adoption of AI in humanitarian contexts, including biometric and medical data technologies, highlighting the need for collaboration between practitioners and researchers to assess the broader implications of these medical data innovations in humanitarianism.[134] Ramezani et al.[41] have presented a research agenda for the use of AI in health governance, including in aspects related to values, goals, objectives, plans, indicators, and indexes. Dwivedi eta al[6] have provided a multi-disciplinary perspective identifying questions requiring further research across three thematic areas: knowledge, transparency, and ethics; digital transformation of organisations and societies; and teaching, learning, and scholarly research. The avenues for further research include: identifying skills, resources, and capabilities needed to handle generative AI; examining biases of generative AI attributable to training datasets and processes; exploring business and societal contexts best suited for generative AI implementation; determining optimal combinations of human and generative AI for various tasks; identifying ways to assess accuracy of text produced by generative AI; and uncovering the ethical and legal issues in using generative AI across different contexts. Based on UK research, Quyoum and Wong[8] argue that power-sensitive, participatory approaches co-designed with minoritised ethnic groups are essential to address systemic injustices and inequalities in AI-driven digital services.

Identity, safety, and 'caring for big data' in research and implementation science

Machine learning and AI can be used to collect and analyse data from diverse social media sources. A study by Khatua and Nejdl[135] examined tweets to identify the voices of migrants and analyse their concerns, employing deep learning and transformer-based models which identified three themes. These provided insights into generic views, initial struggles, and subsequent settlement in the host country. Migrant voices and perspectives are currently also being used in machine learning approaches to generate 'personas' based on qualitative and quantitative datasets in ongoing research.[136]

In a book exploring methodological and ethical challenges in digital migration research, Sandberg et al.[16] emphasised the need for much closer attention to "caring for big data" to ensure that the researcher does not jeopardise migrants' lives and safety. Public universities play a key role by educating researchers to recognise these challenges and engage in regional and global debates on the critical use of AI in an evolving digital landscape. More broadly, universities training future AI professionals must engage in developing and applying ethical principles, especially for AI use with vulnerable and marginalised populations.

There is strong potential for using pragmatic implementation science methods to evaluate how AI can improve health outcomes, including for migrants, while also minimising unintended consequences such as patient harm, inefficiencies in the system, and disparities in care delivery. A roadmap for applying ML techniques to address implementation science questions has been presented.[137]

The way forward

AI holds significant potential to improve health outcomes for migrants, including refugees and asylum seekers, by supporting targeted interventions, enhancing health literacy, and enabling timelier, needs-based access to care. However, efforts to reap these benefits need to be accompanied by high levels of awareness of the challenges and risks. These include the unreliability of AI-generated information, its potential to reinforce inequities among marginalised and gendered communities, limited validation of AI in health care, lack of robust evidence on clinical outcomes, absence of migrant perspectives, and AI use in surveillance and tracking of migrants, especially asylum seekers and refugees. The use of AI as a tool in the management of borders and immigration poses particular risks for migrants who are undocumented, irregular or intending to seek asylum. Effectively balancing the benefits and risks of AI use requires strong international and multi-sector collaboration, a clear understanding of the diverse and individual circumstances of migrants, and a firm commitment to prioritising ethical principles grounded in a human rights framework. While AI offers promising technical tools, it is important to understand that it is not a cure-all for political or social issues such as inhumane treatment or systemic biases and discrimination. Therefore, its applications must be approached with great caution, grounded in the principle of 'do no harm', and carefully monitored during implementation.

Although this paper primarily focuses on the European context, the challenges and opportunities discussed are relevant globally. Migrants often pass through multiple countries before reaching Europe, highlighting AI's potential and risks across regions. Therefore, the findings and recommendations may apply beyond Europe to global migration policies and digital rights frameworks, with applicability varying based on country and migrant circumstances.

Action at the European level involving its governance institutions such as the Council of Europe, EC, and EU along with the World Health Organization (WHO), major tech companies, humanitarian organisations, national governments, and migrants themselves including vulnerable groups like refugees and asylum seekers will be key to advancing a human rights-centred approach for ethical AI use. This action must be supported by continuous human oversight, including expanding the use and effectiveness of Explainable AI or Explainability by Design, legislation, policy development, regulation, and research to set and uphold standards that ensure equity and prevent bias. Urgent progress on this agenda will facilitate the global development of appropriate infrastructure and standards, ensure transparency and accountability in AI use, and build trust among migrants and the organisations serving them. Importantly, it will place the responsibility for ethical AI use on international agencies, governments, and major tech companies, reducing the need for migrants to take defencive measures themselves.

Search strategy and selection criteria

To develop the literature set informing the perspective presented in this Personal View, a detailed and systematic search strategy was implemented across Google, Google Scholar, PubMed, Scopus, ScienceDirect, and open-access databases from pertinent organisations, including the International Organisation for Migration (IOM), EC, EU, and World Health Organization (WHO). The strategy was specifically designed to explore the intersection of artificial intelligence (AI) applications and health outcomes, particularly for migrant and refugee populations. It was based initially on three concepts and combined using Boolean terms (AND, OR): AI AND Migration AND Health. For the first concept, the search terms included "artificial intelligence", "AI" "machine learning" "language models" "chatbot" and "algorithms". These were paired with keywords relevant to the target populations, such as "migration" "migrant" "refugee" "displaced populations" and "displaced community". To address the health theme, terms like "health" "wellbeing" "care" "healthcare" and "mental health" were included. Additionally, to refine the scope and consider regional and ethical dimensions, keywords such as "Europe" "European" "best practice" and "ethics" were incorporated. Co-authors also provided references from their own literature sets as they contributed text to the drafting. After the first complete draft was assembled, an additional literature search was conducted across the above databases, on specific topics that were emerging as important areas in the text, e.g., "AI Ethics" AND "Migrant Health", "AI Bias" AND "Healthcare for Migrants", "Data Privacy" AND "AI" AND "Migrant Health", "AI in mental health for migrants", and "algorithmic discrimination in healthcare". The final reference list was curated based on the relevance and quality of the studies regarding the topics within the extensive scope of the review, as well as priority for papers published in the last five years and papers concerning the European region.

Contributors
SAM and LS conceptualised the manuscript. SAM and IMMC conducted initial literature searches and SAM then grouped the results and mapped out the scope of a preliminary draft, which was completed with inputs of text and further literature on specific topics contributed by AT, GN, JM, LS, and MHZ. The final literature list was curated by SAM. All authors reviewed and edited successive drafts of the manuscript, approved the final version submitted, and contributed to the revisions requested by reviewers. JM undertook final revisions and polishing of the text.

Declaration of interests
We declare no competing interests.

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References

1 Matlin SA, Hanefeld J, Corte-Real A, et al. Digital solutions for migrant and refugee health: a framework for analysis and action. *Lancet Reg Health Eur*. 2025;50:101190. https://doi.org/10.1016/j.lanepe.2024.101190.
2 Nalbandian L. An eye for an 'I': a critical assessment of artificial intelligence tools in migration and asylum management. *Comp Migr Stud*. 2022;10:32. https://doi.org/10.1186/s40878-022-00305-0.
3 International Organization for Migration (IOM). Key migration terms. Geneva. Available from: https://www.iom.int/key-migration-terms; 2024. Accessed March 20, 2025.
4 Frontex – European Border and Coast Guard Agency. *Artificial Intelligence-based Capabilities for the European Border and Coast Guard*. Warsaw: Frontex - European Border and Coast Guard Agency; 2021. Available from: https://www.frontex.europa.eu/assets/Publications/Research/Frontex_AI_Research_Study_2020_final_report.pdf. Accessed March 20, 2025.
5 Maslej N, Fattorini L, Perrault R, et al. *The Artificial Intelligence Index 2024 Annual Report*. Stanford, CA: AI Index Steering Committee, Institute for Human-Centered AI, Stanford University; 2024. Available from: https://aiindex.stanford.edu/wp-content/uploads/2024/04/HAI_2024_AI-Index-Report.pdf. Accessed March 20, 2025.
6 Dwivedi YK, Kshetri N, Hughes L, et al. "So what if ChatGPT wrote it?" Multidisciplinary perspectives on opportunities, challenges and implications of generative conversational AI for research, practice and policy. *Int J Inf Manag*. 2023;71:102642. https://doi.org/10.1016/j.ijinfomgt.2023.102642.
7 OECD Legal Instruments. Recommendation of the Council on Artificial Intelligence. Organization for Economic Cooperation and Development, Paris, amended 3 May 2024, document OECD/LEGAL/0449. Available from: https://legalinstruments.oecd.org/en/instruments/OECD-LEGAL-0449. Accessed March 20, 2025.
8 Quyoum A, Wong M. Valuing lived experience and co-design solutions to counter racial inequality in data and algorithmic systems in UK's digital services. *Inf Commun Soc*. 2024;27:1793–1809. https://doi.org/10.1080/1369118X.2024.2331781.
9 Mittelstadt B, Wachter S, Russell C. To protect science, we must use LLMs as zero-shot translators. *Nat Hum Behav*. 2023;7:1830–1832. https://doi.org/10.1038/s41562-023-01744-0.
10 Shumailov I, Shumaylov Z, Zhao Y, Papernot N, Anderson R, Gal Y. AI models collapse when trained on recursively generated data. *Nature*. 2024;631:755–759. https://doi.org/10.1038/s41586-024-07566-y.
11 Naddaf M. ChatGPT generates fake data set to support scientific hypothesis. *Nature*. 2023;623:895–896. https://doi.org/10.1038/d41586-023-03635-w.
12 Gillham J. 8 times AI hallucinations or factual errors caused serious problems. Originality.ai. Available from: https://originality.ai/blog/ai-hallucination-factual-error-problems; 2024. Accessed March 20, 2025.
13 Zhou L, Schellaert W, Martínez-Plumed F, Moros-Daval Y, Ferri C, Orallo JH. Larger and more instructable language models become less reliable. *Nature*. 2024;634:61–68. https://doi.org/10.1038/s41586-024-07930-y.
14 World Economic Forum. *Global Risk Report 2024*. Geneva: World Economic Forum; 2024. Available from: https://www.weforum.org/publications/global-risks-report-2024/. Accessed March 20, 2025.
15 Hofmann V, Kalluri PR, Jurafsky D, King S. AI generates covertly racist decisions about people based on their dialect. *Nature*. 2024;633:147–154. https://doi.org/10.1038/s41586-024-07856-5.
16 Sandberg M, Rossi L, Galis V, Jørgensen MB, eds. *Research Methodologies and Ethical Challenges in Digital Migration Studies. Caring for (Big) Data?* London: Palgrave Macmillan; 2022. https://doi.org/10.1007/978-3-030-81226-3.
17 Haque AKMB, Islam AKMN, Mikalef P. Explainable Artificial Intelligence (XAI) from a user perspective: a synthesis of prior literature and problematizing avenues for future research. *Technol Forecast Soc Change*. 2023;186:122120. https://doi.org/10.1016/j.techfore.2022.122120.
18 de Bruijn H, Warnier M, Janssen M. The perils and pitfalls of explainable AI: strategies for explaining algorithmic decision-making. *Gov Inf Q*. 2022;39:101666. https://doi.org/10.1016/j.giq.2021.101666.
19 Newman J. *Explainability Won't Save AI*. Washington DC: Brookings Institution; 2021. Available from: https://www.brookings.edu/articles/explainability-wont-save-ai/. Accessed March 20, 2025.
20 Abdelrahman M. Trauma apps and the making of the 'smart' refugee. *Environ Plann Soc Space*. 2023;41:513–528. https://doi.org/10.1177/02637758231173416.
21 Singleton A. Migration and asylum data for policy-making in the European Union: the Problem with Numbers, CEPS Papers in Liberty and Security in Europe No. 89. Available from: www.ceps.eu/cepspublications/migration-and-asylum-data-policy-making-european-union-problem-numbers/; 2016. Accessed March 20, 2025.
22 European Migration Network. The use of digitalisation and artificial intelligence in migration management. Organization for Economic Development, Paris and European Migration Network, Brussels, EMN-OECD INFORM. Available from: https://emn.ie/publications/the-use-of-digitalisation-and-artificial-intelligence-in-migration-management/; 2022. Accessed March 20, 2025.
23 Bircan T, Korkmaz EE. Big data for whose sake? Governing migration through artificial intelligence. *Humanit Soc Sci Commun*. 2021;8:241. https://doi.org/10.1057/s41599-021-00910-x.
24 Kinchin N, Mougouei D. What can artificial intelligence do for refugee status determination? A proposal for removing subjective fear. *Int J Refug Law*. 2022;34:373–397. https://doi.org/10.1093/ijrl/eeac040.
25 Hellenic Data Protection Authority. *Ministry of Migration and Asylum Receives Administrative Fine and GDPR Compliance Order Following an Own-initiative Investigation by the Hellenic Data Protection Authority*. Athens: Hellenic Data Protection Authority; 2024. Available from: https://www.dpa.gr/en/enimerwtiko/press-releases/ministry-migration-and-asylum-receives-administrative-fine-and-gdpr. Accessed March 20, 2025.
26 Forster M. *Refugee Protection in the Artificial Intelligence Era. A Test Case for Rights*. London: Chatham House; 2022. Available from: https://www.chathamhouse.org/sites/default/files/2022-09/2022-09-07-refugee-protection-artificial-intelligence-era-forster.pdf. Accessed March 20, 2025.
27 Guillén A, Teodoro E. Embedding ethical principles into AI predictive tools for migration management in humanitarian action. *Soc Sci*. 2023;12(2):53. https://doi.org/10.3390/socsci12020053.
28 Oishi A, Teshima T, Akao K, et al. Forecasting internally displaced people's movements with artificial intelligence. In: Boateng R, Boateng SL, Anning-Dorson T, Olumide Babatope L, eds. *Digital Innovations, Business and Society in Africa. Advances in Theory and Practice of Emerging markets*. Cham: Springer; 2022:311–339. https://doi.org/10.1007/978-3-030-77987-0_14. Ch 14.
29 Beduschi A. Harnessing the potential of artificial intelligence for humanitarian action: opportunities and risks. *Int Rev Red Cross*. 2022;104(919):1149–1169. https://doi.org/10.1017/S1816383122000261.

30 Xanthopoulou E. Mapping EU externalisation devices through a critical eye. *Eur J Migrat Law*. 2024;26:108–135. https://doi.org/10.1163/15718166-12340170.

31 Fournier-Tombs E, Castets-Renard C. Protecting migrants against the risks of artificial intelligence technologies. In: *The Impacts of COVID-19 on Migration and Migrants from a Gender Perspective*. Geneva: International Organization for Migration; 2022:171–184. Ch 12. Available from: https://publications.iom.int/system/files/pdf/impacts-of-COVID-19-gender_1.pdf. Accessed March 20, 2025.

32 Ahmed N, Wahed M, Thompson NC. The growing influence of industry in AI research. *Science*. 2023;379(6635):884–886. https://doi.org/10.1126/science.ade2420.

33 Hashiguchi TCO, Oderkirk J, Slawomirski L. Fulfilling the promise of Artificial Intelligence in the health sector: let's get real. *Value Health*. 2022;25(3):368–373. https://doi.org/10.1016/j.jval.2021.11.1369.

34 UK Government. *The Bletchley Declaration by Countries Attending the AI Safety Summit, 1-2 November 2023*. Policy paper. London: UK Government; 2023. Available from: https://www.gov.uk/government/publications/ai-safety-summit-2023-the-bletchley-declaration/the-bletchley-declaration-by-countries-attending-the-ai-safety-summit-1-2-november-2023. Accessed March 20, 2025.

35 OECD. *OECD AI Principles Overview*. Paris: OECD AI Policy Observatory, Organization for Economic Cooperation and Development; 2024. Available from: https://oecd.ai/en/ai-principles. Accessed March 20, 2025.

36 European Parliament. *Artificial Intelligence Act*. Brussel & Strasbourg: European Parliament; 2024. Consolidated text. Available from: https://www.europarl.europa.eu/doceo/document/TA-9-2024-0138_EN.html#title2. Accessed March 20, 2025.

37 EDRi. *The EU's Artificial Intelligence Act: Civil Society Amendments*. European Digital Rights (EDRi); 2022. Available from: https://edri.org/our-work/the-eus-artificial-intelligence-act-civil-society-amendments/. Accessed March 20, 2025.

38 Avsec K. *Joint Statement: A Dangerous Precedent: How the EU AI Act Fails Migrants and People on the Move*. Brussels: NERR; 2024. Available from: https://www.enar-eu.org/joint-statement-a-dangerous-precedent-how-the-eu-ai-act-fails-migrants-and-people-on-the-move/. Accessed March 20, 2025.

39 Krauel E, Frewer A. Dual use concerns in artificial intelligence and the neurosciences: how medical research can end up in war. *Res Ethics*. 2024;21:331–345. https://doi.org/10.1177/17470161241262149.

40 Larsen BC, Küspert S. *Regulating General-purpose AI: Areas of Convergence and Divergence Across the EU and the US*. Washington DC: Brookings Institution; 2024. Available from: https://www.brookings.edu/articles/regulating-general-purpose-ai-areas-of-convergence-and-divergence-across-the-eu-and-the-us/. Accessed March 20, 2025.

41 Ramezani M, Takian A, Bakhtiari A, Rabiee HR, Ghazanfari S, Sazgarnejad S. Research agenda for using artificial intelligence in health governance: interpretive scoping review and framework. *BioData Min*. 2023;16:31. https://doi.org/10.1186/s13040-023-00346-w.

42 Hamet P, Tremblay J. Artificial intelligence in medicine. *Metabolism*. 2017;69:S36–S40. https://doi.org/10.1016/j.metabol.2017.01.011.

43 Yang X, Chen A, PourNejatian N, et al. A large language model for electronic health records. *NPJ Digit Med*. 2022;5:194. https://doi.org/10.1038/s41746-022-00742-2.

44 Wani SUD, Khan NA, Thakur G, et al. Utilization of artificial intelligence in disease prevention: diagnosis, treatment, and implications for the healthcare workforce. *Healthcare (Basel)*. 2022;10(4):608. https://doi.org/10.3390/healthcare10040608.

45 Taherdoost H, Ghofrani A. AI's role in revolutionizing personalized medicine by reshaping pharmacogenomics and drug therapy. *Intell Pharm*. 2024;2:643–650. https://doi.org/10.1016/j.ipha.2024.08.005.

46 Alowais SA, Alghamdi SS, Alsuhebany N, et al. Revolutionizing healthcare: the role of artificial intelligence in clinical practice. *BMC Med Educ*. 2023;23:689. https://doi.org/10.1186/s12909-023-04698-z.

47 Towards Healthcare. *AI in Healthcare Market Size Envisioned at USD 355.78 Billion Market by 2032*. Pune: Towards Healthcare; 2023. Available from: https://www.towardshealthcare.com/insights/ai-in-healthcare-market. Accessed March 20, 2025.

48 Aerts A, Bogdan-Martin D. Leveraging data and AI to deliver on the promise of digital health. *Int J Med Inf*. 2021;150:104456. https://doi.org/10.1016/j.ijmedinf.2021.104456.

49 Garcia JF, Spatharou A, Jenkins J, et al. *Transforming Healthcare With AI. The Impact on the Workforce and Organisations*. London: McKinsey & Co; 2020. Available from: https://www.mckinsey.com/industries/healthcare/our-insights/transforming-healthcare-with-ai#/. Accessed March 20, 2025.

50 Briganti G, Le Moine O. Artificial intelligence in medicine: today and tomorrow. *Front Med*. 2020;7:00027. https://doi.org/10.3389/fmed.2020.00027.

51 Krishnan G, Singh S, Pathania M, et al. Artificial intelligence in clinical medicine: catalyzing a sustainable global healthcare paradigm. *Front Artif Intell*. 2023;6:1227091. https://doi.org/10.3389/frai.2023.1227091.

52 Schlieter H, Gand K, Marsch L, Chan WS, Kowatsch Y. Scaling-up health-IT-sustainable digital health implementation and diffusion. *Front Digit Health*. 2024;6:1296495. https://doi.org/10.3389/fdgth.2024.1296495.

53 Petersson L, Larsson I, Nygren JM, et al. Challenges to implementing artificial intelligence in healthcare: a qualitative interview study with healthcare leaders in Sweden. *BMC Health Serv Res*. 2022;22:850. https://doi.org/10.1186/s12913-022-08215-8.

54 Martinez-Millana A, Saez-Saez A, Tornero-Costa R, Azzopardi-Muscat N, Traver V, Novillo-Ortiz D. Artificial intelligence and its impact on the domains of universal health coverage, health emergencies and health promotion: an overview of systematic reviews. *Int J Med Inf*. 2022;166:104855. https://doi.org/10.1016/j.ijmedinf.2022.104855.

55 Rajpurkar P, Chen E, Banerjee O, Topol EJ. AI in health and medicine. *Nat Med*. 2022;28:31–38. https://doi.org/10.1038/s41591-021-01614-0.

56 Göndöcs D, Dörfler V. AI in medical diagnosis: AI prediction & human judgment. *Artif Intell Med*. 2024;149:102769. https://doi.org/10.1016/j.artmed.2024.102769.

57 Goodman KE, Yi PH, Morgan DJ. AI-generated clinical summaries require more than accuracy. *JAMA*. 2024;331:637–638. https://doi.org/10.1001/jama.2024.0555.

58 Beede E, Baylor E, Hersch F, et al. A Human-centered evaluation of a deep learning system deployed in clinics for the detection of diabetic retinopathy. In: *Proc. 2020 CHI Conference on Human Factors in Computing Systems*. 2020. https://doi.org/10.1145/3313831.3376718.

59 Singh K, Valley TS, Tang S, et al. Evaluating a widely implemented proprietary deterioration index model among hospitalized patients with COVID-19. *Ann Am Thorac Soc*. 2021;18:1129–1137. https://doi.org/10.1513/AnnalsATS.202006-698OC.

60 Wong A, Otles E, Donnelly JP, et al. External validation of a widely implemented proprietary sepsis prediction model in hospitalized patients. *JAMA Intern Med*. 2021;181:1065–1070. https://doi.org/10.1001/jamainternmed.2021.2626.

61 Alkaissi H, McFarlane SI. Artificial hallucinations in ChatGPT: implications in scientific writing. *Cureus*. 2023;15(2):e35179. https://doi.org/10.7759/cureus.35179.

62 Germani F, Spitale G, Biller-Andorno N. The dual nature of AI in information dissemination: ethical considerations. *JMIR AI*. 2024;3:e53505. https://doi.org/10.2196/53505.

63 Thompson J. *AI Tool Predicts Whether Online Health Misinformation Will Cause Real-world Harm*. Sci American; 2024. Available from: https://www.scientificamerican.com/article/ai-tool-predicts-whether-online-health-misinformation-will-cause-real-world/. Accessed March 20, 2025.

64 Venkat E. *AI Misinformation Has Set Back Pandemic Preparedness*. The Johns Hopkins News-Letter; 2024. Available from: https://www.jhunewsletter.com/article/2024/10/ai-misinformation-has-set-back-pandemic-preparedness. Accessed March 20, 2025.

65 Union for International Cancer Control (UICC). *No Laughing Matter: Navigating the Perils of AI and Medical Misinformation*. Geneva: Union for International Cancer Control; 2024. Available from: https://www.uicc.org/news/no-laughing-matter-navigating-perils-ai-and-medical-misinformation. Accessed March 20, 2025.

66 Rose L, Bewley S, Payne M, Colquhoun D, Perry S. Using artificial intelligence (AI) to assess the prevalence of false or misleading health-related claims. *R Soc Open Sci*. 2024;11:11240698. https://doi.org/10.1098/rsos.240698.

67 Monteith S, Glenn T, Geddes JR, Whybrow PC, Achtyes E, Bauer M. Artificial intelligence and increasing misinformation. *Br J Psychiatry*. 2024;224:33–35. https://doi.org/10.1192/bjp.2023.136.

68 Boston University, Center on Emergning Infectious Disease. *How Can We Tackle AI-fueled Misinformation and Disinformation in Public Health?* Boston University; 2024. Available from: https://

www.bu.edu/ceid/2024/04/25/how-can-we-tackle-ai-fueled-misinformation-and-disinformation-in-public-health/. Accessed March 20, 2025.
69 Khemani B, Bhattacharya A, Patil S. Health misinformation detection using AI-based techniques: comparative analysis. In: Hassanien AE, Anand S, Jaiswal A, Kumar P, eds. *Innovative Computing and Communications. ICICC 2024. Lecture Notes in Networks and Systems*. vol. 1043. Singapore: Springer; 2024. https://doi.org/10.1007/978-981-97-4228-8_33.
70 Wang HE, Landers M, Adams R, et al. A bias evaluation checklist for predictive models and its pilot application for 30-day hospital readmission models. *J Am Med Inform Assoc*. 2022;29(8):1323–1333. https://doi.org/10.1093/jamia/ocac065.
71 Rajkomar A, Hardt M, Howell MD, Corrado G, Chin MH. Ensuring fairness in machine learning to advance health equity. *Ann Intern Med*. 2018;169(12):866–872. https://doi.org/10.7326/M18-1990.
72 Giovanola B, Tiribelli S. Beyond bias and discrimination: redefining the AI ethics principle of fairness in healthcare machine-learning algorithms. *AI Soc*. 2023;38(2):549–563. https://doi.org/10.1007/s00146-022-01455-6.
73 Ameen S, Wong MC, Yee KC, Turner P. AI and clinical decision making: the limitations and risks of computational reductionism in bowel cancer screening. *Appl Sci*. 2022;12(7):3341. https://doi.org/10.3390/app12073341.
74 Chin MH, Afsar-Manesh N, Bierman AS, et al. Guiding principles to address the impact of algorithm bias on racial and ethnic disparities in health and health care. *JAMA Netw Open*. 2023;6(12):e2345050. https://doi.org/10.1001/jamanetworkopen.2023.45050.
75 Lee MK, Rich K. Who is included in human perceptions of AI? Trust and perceived fairness around healthcare AI and cultural mistrust. In: *Proc 2021 CHI Conference on Human Factors in Computing Systems*. vol. 138. 2021:1–14. https://doi.org/10.1145/3411764.3445570.
76 Zack T, Lehman E, Suzgun M, et al. Assessing the potential of GPT-4 to perpetuate racial and gender biases in health care: a model evaluation study. *Lancet Digit Health*. 2024;6:e12–e22. https://doi.org/10.1016/S2589-7500(23)00225-X.
77 Yang Y, Zhang H, Gichoya JW, Katabi D, Ghassemi M. The limits of fair medical imaging AI in real-world generalization. *Nat Med*. 2024;30:2838–2848. https://doi.org/10.1038/s41591-024-03113-4.
78 Band SSD, Yarahmadi A, Hsu CC, et al. Application of explainable artificial intelligence in medical health: a systematic review of interpretability methods. *Inform Med Unlocked*. 2023;40:101286. https://doi.org/10.1016/j.imu.2023.101286.
79 Hulsen T. Explainable artificial intelligence (XAI): concepts and challenges in healthcare. *AI*. 2023;4:652–666. https://doi.org/10.3390/ai4030034.
80 Moreau L, Huynh D. *Explainability by Design*. Kings College London; 2022. Available from: https://www.kcl.ac.uk/news/explainability-by-design. Accessed March 20, 2025.
81 Kisa S, Kisa A. "No Papers, No Treatment": a scoping review of challenges faced by undocumented immigrants in accessing emergency healthcare. *Int J Equity Health*. 2024;23:184. https://doi.org/10.1186/s12939-024-02270-9.
82 Stevenson K, Antia K, Burns R, et al. Universal health coverage for undocumented migrants in the WHO European region: a long way to go. *Lancet Reg Health Eur*. 2024;41:100803. https://doi.org/10.1016/j.lanepe.2023.100803.
83 Ressi D, Romanello R, Piazza C, Rossi S. AI-enhanced blockchain technology: a review of advancements and opportunities. *J Netw Comput Appl*. 2024;225:103858. https://doi.org/10.1016/j.jnca.2024.103858.
84 Kumar R, Arjunaditya, Singh D, Srinivasan K, Hu YC. AI-powered blockchain technology for public health: a contemporary review, open challenges, and future research directions. *Healthcare (Basel)*. 2023;11:81. https://doi.org/10.3390/healthcare11010081.
85 Jahani S, Dehghanian Z, Takian A. ChatGPT and refugee's health: innovative solutions for changing the game. *Int J Public Health*. 2024;69:1607306. https://doi.org/10.3389/ijph.2024.1607306.
86 G'sell F, Martin-Bariteau F. *The Impact of Blockchains for Human Rights, Democracy, and the Rule of Law. An Overview Report*. Brussels: Information Society Department, Council of Europe; 2022. DGI(2022)06. Available from: https://rm.coe.int/report-on-blockchains-en/1680a8ffc0&ved=2ahUKEwi3hfzJz5KHAxVAXUEAHc9wD204PBAWegQIExAB&usg=AOvVaw3_fnSyB6IgdlaHoHeD02hN. Accessed March 20, 2025.
87 Ruokolainen H, Widén G. Conceptualising misinformation in the context of asylum seekers. *Inf Process Manag*. 2020;57:102127. https://doi.org/10.1016/j.ipm.2019.102127.
88 Villasenor J. *How to Deal With AI-enabled Disinformation*. Washington DC: Brookings Institution; 2020. Available from: https://www.brookings.edu/articles/how-to-deal-with-ai-enabled-disinformation/. Accessed March 20, 2025.
89 Kreps S. *The Role of Technology in Online Misinformation*. Washington DC: Brookings Institution; 2020. Available from: https://www.brookings.edu/wp-content/uploads/2020/06/The-role-of-technology-in-online-misinformation.pdf. Accessed March 20, 2025.
90 Costello T, Pennycook G, Rand DG. Durably reducing conspiracy beliefs through dialogues with AI. *Science*. 2024;385(6714):eadq1814. https://doi.org/10.1126/science.adq1814.
91 Beduschi A, McAuliffe M. Artificial Intelligence, migration and mobility: implications for policy and practice. In: McAuliffe M, Triandafyllidou A, eds. *World Migration Report 2022*. Geneva: International Organization for Migration; 2022. Available from: https://publications.iom.int/system/files/pdf/wmr-2022-en-ch-11_0.pdf. Accessed March 20, 2025.
92 Sequeira-Aymar E, Cruz A, Serra-Burriel M, et al. Improving the detection of infectious diseases in at-risk migrants with an innovative integrated multi-infection screening digital decision support tool (IS-MiHealth) in primary care: a pilot cluster-randomized-controlled trial. *J Travel Med*. 2022;29:115177. https://doi.org/10.1093/jtm/taab100.
93 Jarral R, Kells T, Lin NY, Mason-Mackay A, Sharma K. Artificial intelligence for humanitarian action: an interdisciplinary approach to communicable diseases in refugees. *BMJ Lead*. 2019;3(Suppl 1):52. https://doi.org/10.1136/leader-2019-FMLM.52.
94 Park KK, Saleem M, Al-Garadi MA, Ahmed A. Machine learning applications in studying mental health among immigrants and racial and ethnic minorities: an exploratory scoping review. *BMC Med Inform Decis Mak*. 2024;24:298. https://doi.org/10.1186/s12911-024-02663-4.
95 Katsoulakis E, Wang Q, Wu H, et al. Digital twins for health: a scoping review. *NPJ Digit Med*. 2024;7:77. https://doi.org/10.1038/s41746-024-01073-0.
96 Ayobi A, Eardley R, Soubutts E, Gooberman-Hill R, Craddock I, O'Kane AA. Digital mental health and social connectedness: experiences of women from refugee backgrounds. *Proc ACM Hum Comput Interact*. 2022;6:1–27. https://doi.org/10.1145/3555620.
97 Tseng YC, Jarupreechachan W, Lee TH. Understanding the benefits and design of chatbots to meet the healthcare needs of migrant workers. *Proc ACM Hum Comput Interact*. 2023;7(CSCW2):315. https://doi.org/10.1145/3610106.
98 United Nations Development Programme (UNDP). *Gender Equality in Digitalization*. Istanbul: United Nations Development Programme, Regional Bureau for Europe and the CIS; 2021. Available from: https://www.undp.org/sites/g/files/zskgke326/files/migration/kg/gender_equality_in_digitalization.pdf. Accessed March 20, 2025.
99 Seh AH, Zarour M, Alenezi M, et al. Healthcare data breaches: insights and implications. *Healthcare (Basel)*. 2020;8:133. https://doi.org/10.3390/healthcare8020133.
100 Roscoe P. *Reining in the Wild West of AI*. Medcity News; 2024. Available from: https://medcitynews.com/2024/07/reining-in-the-wild-west-of-ai/. Accessed March 20, 2025.
101 Denniston AK, Lu X. Responsible and evidence-based AI: 5 years on. *Lancet Digit Health*. 2024;6:e305–e307. https://doi.org/10.1016/S2589-7500(24)00071-2.
102 European Commission. Proposal for a regulation of the European Parliament and of the Council on the European Health Data space. European Commission, Strasbourg, COM/2022/197 final, Document 52022PC0197. Available from: https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:52022PC0197; 2022. Accessed March 20, 2025.
103 European Commission. *AI Act*. Brussels: European Commission; 2024. Available from: https://digital-strategy.ec.europa.eu/en/policies/regulatory-framework-ai. Accessed March 20, 2025.
104 Flowers T, Wu P, Lipstaite S. *The EU AI Act: Implications for the Health Sector*. London: Access Partnership; 2024. Available from: https://accesspartnership.com/the-eu-ai-act-implications-for-the-health-sector/. Accessed March 20, 2025.
105 Gilbert S. The EU passes the AI Act and its implications for digital medicine are unclear. *NPJ Digit Med*. 2024;7:135. https://doi.org/10.1038/s41746-024-01116-6.

106 van Kolfschooten H, van Oirschot J. The EU Artificial Intelligence Act (2024): implications for healthcare. *Health Policy*. 2024;149:105152. https://doi.org/10.1016/j.healthpol.2024.105152.

107 Schmidt J, Schutte NM, Buttigieg S, et al. Mapping the regulatory landscape for artificial intelligence in health within the European Union. *NPJ Digit Med*. 2024;7:229. https://doi.org/10.1038/s41746-024-01221-6.

108 Solaiman B, Malik A. Regulating algorithmic care in the European Union: evolving doctor–patient models through the Artificial Intelligence Act (AI-Act) and the liability directives. *Med Law Rev*. 2025;33:fwae033. https://doi.org/10.1093/medlaw/fwae033.

109 Brouwer E. *EU's AI Act and Migration Control: Shortcomings in Safeguarding Fundamental Rights*. Verfassungsblog; 2024. Available from: https://verfassungsblog.de/eus-ai-act-and-migration-control-shortcomings-in-safeguarding-fundamental-rights/. Accessed March 20, 2025.

110 Platform for International Cooperation on Undocumented Migrants. *A Dangerous Precedent: How the EU AI Act Fails Migrants and People on the Move*. Brussels: PICUM; 2024. Available from: https://picum.org/blog/a-dangerous-precedent-how-the-eu-ai-act-fails-migrants-and-people-on-the-move/. Accessed March 20, 2025.

111 Buslón N, Cortés A, Catuara-Solarz S, Cirillo D, Rementeria MJ. Raising awareness of sex and gender bias in artificial intelligence and health. *Front Glob Womens Health*. 2023;4:970312. https://doi.org/10.3389/fgwh.2023.970312.

112 Claypool H, Carey C, Hart AC, Lassiter L. *Centering Disability in Technology Policy: Issue Landscape and Potential Opportunities for Action*. American Association of People with Disabilities, Washington DC and Center for Democracy & Technology, Washington DC; 2021. Available from: https://cdt.org/wp-content/uploads/2021/12/centering-disability-120821-1326-final.pdf. Accessed March 20, 2025.

113 Vyas DA, Eisenstein LG, Jones DS. Hidden in Plain Sight – reconsidering the use of race correction in clinical algorithms. *N Engl J Med*. 2020;383:874–882. https://doi.org/10.1056/NEJMms2004740.

114 Gerards J, Xenidis R. *Algorithmic Discrimination in Europe: Challenges and Opportunities for Gender Equality and Non-discrimination Law*. European Commission: Directorate-General for Justice and Consumers, European Network Of Legal Experts in Gender Equality and Non-discrimination, Publications Office; 2021. Available from: https://op.europa.eu/en/publication-detail/-/publication/082f1dbc-821d-11eb-9ac9-01aa75ed71a1/language-en. Accessed March 20, 2025.

115 Wójcik MA. Algorithmic Discrimination in health care: an EU law perspective. *Health Hum Rights*. 2022;24(1):93–103. Available from: https://europepmc.org/article/med/35747275. Accessed March 20, 2025.

116 Tilala MH, Chenchala PK, Choppadandi A, et al. Ethical considerations in the use of artificial intelligence and machine learning in health care: a comprehensive review. *Cureus*. 2024;16(6):e62443. https://doi.org/10.7759/cureus.62443.

117 Bozorgmehr K, McKee M, Azzopardi-Muscat N, et al. Integration of migrant and refugee data in health information systems in Europe: advancing evidence, policy and practice. *Lancet Reg Health Eur*. 2023;34:100744. https://doi.org/10.1016/j.lanepe.2023.100744.

118 European Centre for Disease Prevention and Control. *Public Health Guidance on Screening and Vaccination for Infectious Diseases in Newly Arrived Migrants Within the EU/EEA*. Stockholm: European Centre for Disease Prevention and Control; 2018. https://doi.org/10.2900/154411. Accessed March 20, 2025.

119 Abubakar I, Matteelli A, De Vries G, et al. Towards tackling tuberculosis in vulnerable groups in the European Union: the E-DETECT TB consortium. *Eur Respir J*. 2018;51:1702604. https://doi.org/10.1183/13993003.02604-2017.

120 Kazemzadeh S, Yu J, Jamshy S, et al. Deep Learning detection of active pulmonary tuberculosis at chest radiography matched the clinical performance of radiologists. *Radiology*. 2023;306:124–137. https://doi.org/10.1148/radiol.212213.

121 David PM, Onno J, Keshavjee S, Khan FA. Conditions required for the artificial-intelligence-based computer-aided detection of tuberculosis to attain its global health potential. *Lancet Digit Health*. 2022;4:e702–e704. https://doi.org/10.1016/S2589-7500(22)00172-8.

122 World Health Organization. *WHO Operational Handbook on Tuberculosis: Module 2: Screening: Systematic Screening for Tuberculosis Disease*. Geneva: World Health Organization; 2021. Available from: https://iris.who.int/bitstream/handle/10665/340256/9789240022614-eng.pdf. Accessed March 20, 2025.

123 Creswell J, Vo LNQ, Qin ZZ, et al. Early user perspectives on using computer-aided detection software for interpreting chest X-ray images to enhance access and quality of care for persons with tuberculosis. *BMC Glob Public Health*. 2023;1:30. https://doi.org/10.1186/s44263-023-00033-2.

124 Gelaw SM, Kik SV, Ruhwald M, et al. Diagnostic accuracy of three computer-aided detection systems for detecting pulmonary tuberculosis on chest radiography when used for screening: analysis of an international, multicenter migrants screening study. *PLOS Glob Public Health*. 2023;3:e0000402. https://doi.org/10.1371/journal.pgph.0000402.

125 Qin ZZ, Van der Walt M, Moyo S, et al. Computer-aided detection of tuberculosis from chest radiographs in a tuberculosis prevalence survey in South Africa: external validation and modelled impacts of commercially available artificial intelligence software. *Lancet Digit Health*. 2024;6:e605–e613. https://doi.org/10.1016/S2589-7500(24)00118-3.

126 Mabil-Atem JM, Gumuskaya O, Wilson RL. Digital mental health interventions for the mental health care of refugees and asylum seekers: integrative literature review. *Int J Ment Health Nurs*. 2024;33:760–780. https://doi.org/10.1111/inm.13283.

127 El-Refaay SMM, Toivanen-Atilla K, Crego N. Efficacy of technology-based mental health interventions in minimizing mental health symptoms among in immigrants, asylum seekers or refugees; systematic review. *Arch Psychiatr Nurs*. 2024;51:38–47. https://doi.org/10.1016/j.apnu.2024.04.002.

128 Hadad J, Teytelboym A. Improving refugee resettlement: insights from market design. *Oxf Rev Econ Pol*. 2022;38:434–448. https://doi.org/10.1093/oxrep/grac013.

129 Drydakis N. Mobile applications aiming to facilitate immigrants' societal integration and overall level of integration, health and mental health. Does artificial intelligence enhance outcomes? *Comput Hum Behav*. 2021;117:106661. https://doi.org/10.1016/j.chb.2020.106661.

130 Islam F, Bailey S, Netto G. Digitalised primary care in the UK: the experiences of minoritised ethnic communities. *Br J Gen Pract*. 2024;74(749):e823–e831. https://doi.org/10.3399/BJGP.2024.0308.

131 World Health Organization. *Global Research Agenda on Health, Migration and Displacement: Strengthening Research and Translating Research Priorities into Policy and Practice*. Geneva: World Health Organization; 2023. Available from: https://www.who.int/publications/i/item/9789240082397. Accessed March 20, 2025.

132 MacFarlane A, Huschke S, Marques MJ, et al. Normalising participatory health research approaches in the WHO European region for refugee and migrant health: a paradigm shift. *Lancet Reg Health Eur*. 2024;41:100837. https://doi.org/10.1016/j.lanepe.2024.100837.

133 Vaughn LM, Jacquez F. Participatory research methods – choice points in the research process. *J Participatory Res Methods*. 2020;1(1). https://doi.org/10.35844/001c.13244.

134 Stellmach D, Pinaud M, Tudor M, Fast L. Problematising medical data in humanitarian response. *J Humanit Affairs*. 2023;5(2):3–12. https://doi.org/10.7227/jha.105.

135 Khatua A, Nejdl W. Struggle to settle down! Examining the voices of migrants and refugees on twitter platform. In: *Companion Publication of the 2021 Conference on Computer Supported Cooperative Work and Social Computing*. 2021:95–98. https://doi.org/10.1145/3462204.3481773.

136 PRIME. *The Protecting Minority Ethnic Communities Online (PRIME) Project*. UK: PRIME; 2024. Available from: https://www.primecommunities.online/about. Accessed March 20, 2025.

137 Huguet N, Chen J, Parikh RB. Applying machine learning techniques to implementation science. *Online J Public Health Inform*. 2024;16:e50201. https://doi.org/10.2196/50201.