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Defining precision health: A scoping review protocol

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Defining precision health: A scoping review protocol

Ryan, J.C.[1,2] [author for correspondence - jillian.ryan@csiro.au], Viana, J. N. M.,[3,4], Sellak, H.[1,5], Gondalia, S.V.[1,2], & O'Callaghan, N.[1]

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Abstract

Introduction

Precision health is a nascent field of research that would benefit from clearer operationalisation and distinction from adjacent fields like precision medicine. This clarification is necessary to enable precision health science to tackle some of the most complex and significant health problems that are faced globally. The aim of this review is to examine the progress in human precision health research in the past 10 years and analyse this data to (1) find a common ground and determine discordances in how precision health is operationalised in the literature and (2) identify gaps and future directions in the precision health research field.

Methods and analysis

This scoping review will be undertaken and reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses – Scoping Review Extension (PRISMA-ScR, 1). A systematic search of scientific databases (Medline, Embase, Scopus, Web of Science, and PsycInfo) and grey literature sources (Google Scholar, Google Patents) was undertaken to identify potentially-eligible articles published from 1 January 2010 to 30 June 2020. A total of 8053 articles were imported for screening. 4863 articles were identified as duplicates by Covidence and removed, leaving 3190 studies for screening. 20% of articles will be screened for eligibility in independent duplicate by members of the authorship team, first by title and abstract and then by full text, with the remaining 80% of articles screened by individual authors. Article data will be extracted using a standardised extraction template and analysed descriptively using narrative synthesis.

Ethics and dissemination

Ethics approval is not required. Findings will be disseminated through professional networks, conference presentations, and publication in a scientific journal.

Strengths and limitations of this study

- This study will be the first to systematically identify and review research in the nascent field of precision health. Research will be identified using a comprehensive and systematic search strategy with a broad operationalisation of precision health.

- The review will take a rigorous approach, adhering to PRISMA-ScR guidelines and conducting abstract screening, full text screening, and data extraction for a portion of the studies in independent duplicate to facilitate greater inter-reviewer reliability.
- The analysis is expected to pinpoint significant concentrations and gaps in precision health research in relation to studied populations, health parameters, disease states, and research methods. Insights from these can highlight promising future directions for this rapidly growing scientific field.
- A limitation is that only articles in English will be reviewed.

Background

Supporting the health and wellbeing of a growing population, in the context of aging populations and increasingly prevalent chronic diseases, remains one of the most complex and pressing global challenges (2). Chronic diseases such as cardiovascular disease, chronic respiratory disease, type 2 diabetes, and cancers, carry enormous social, medical, and economic burdens (3). Furthermore, the aetiology of these non-communicable diseases is largely rooted in lifestyle and environmental factors that are difficult to disrupt, given the nature of modern environments and occupations (4). In many countries, over-nutrition (as a primary driver of non-communicable disease) sits alongside under- and mal- nutrition within the same population (5), highlighting the complexity and 'super-wicked' nature of the global health challenges that we face (6).

Precision health is a nascent scientific discipline that is seeking a paradigm shift in health and medical science by integrating information about inter-individual variability in genetic, behavioural, and environmental determinants of health together to form proactive solutions for health problems (7). In this way, precision health is not just about enhanced risk profiling and population stratification, but it must also encompass how that information is used to improve people's health. As an illustration of this vision, a precision health system might see health co-managed proactively by patients and health care providers through the synchronous integration of information – starting with genotyping at birth, regular screening throughout the lifespan, and combined with continuous health monitoring and the provision of actionable advice and early intervention at the precise moment when the individual needs it (7). A current example is the Integrated Human Microbiome Project that seeks to improve health outcomes for pre-term babies, inflammatory bowel disease, and type two diabetes through the development and integration of longitudinal multi -omic and functional data about the host (8). In another example, scientists, through the application of machine-learning techniques to data from more than 500,000 pregnant women, developed a new predictive model for gestational diabetes mellitus that had just nine questions, representing a cost-effective condition screening tool that can significantly advance women's health (8).

Aside from these early examples, fulfilling the vision of precision health and wellbeing for all is still far away from realisation. Precision health is in its infancy, having been formalised as a progeny of precision medicine only in the last decade. It is also highly multi-disciplinary, attempting to incorporate behavioural, environmental, and multi -omic information into cohesive interventions and products that are effective and patient-centred. As such, one of the current challenges within precision health is its apparent rapid growth combined with a lack of consensus on how it is defined across multiple scientific and medical domains (9). Addressing this challenge is the focus of this scoping review.

One of the difficulties with defining or operationalising precision health is its entanglement with adjacent disciplines, particularly precision medicine, which uses advanced -omics testing to customize medical treatments based on an individual's unique biomarker profiles (10). Juengst et al. (11) referred to "*three critical rebranding episodes in contemporary genomics*: (1) the recent transition from personalised to precision medicine; (2) the ongoing transition from precision medicine to precision health; and (3) the incipient transition from precision health to wellness genomics". This ongoing transition started with efforts to conceptualise the application of human genomics to healthcare and the unconventional idea of individualising treatment and empowering patients to take more responsibility for their own health. Then, interests shifted towards giving clinicians better tools and more authority to use genomic information under the rubric of precision medicine, which in turn led to the movement's importing public health goals and expanding its scope to precision prevention at the population level (12). Reviews of early precision medicine research indicate progress towards significant advancements in medical science, such as metabolomics (particularly for drug discovery, see 10) and targeted immunotherapies to treat cancers (13). Today, the process of merging precision medicine and precision prevention in precision health is giving incipient evidence of another game-changing vision– wellness genomics, which is predicted to achieve goals beyond healthcare (11). Clarifying a shared understanding of precision health and its aims is needed to realise the full potentials of precision health and wellness genomics.

Study Rationale

Over the past decade, precision health has grown quickly as a scientific discipline. However, it is still a long way away from realising its promise, which will require interdisciplinary collaboration on an unprecedented scale (9, 14). The lack of a clear definition of precision health and the interchangeable use of terms such as 'precision medicine', 'personalised health', 'precision health', and even 'precision wellness' present a major obstacle to progress in the field (14, 15). Reviewing how precision health is currently operationalised in existing literature is also needed to facilitate more responsible innovation (16) through better identification of ethical, legal, and societal concerns arising from studies tagged as precision health research (see 17, 18). Although precision and personalised medicine research has been extensively reviewed (19-22); to date, no systematic or scoping reviews of precision health research exist. In order to address this challenge, a scoping review of peer-reviewed and grey literature articles focusing on or mentioning "precision health" and its derivatives will be conducted.

Review Objectives

The primary objectives of this scoping review are to map the current state of human precision health research, specifically to:

1. Summarise precision health research study characteristics (e.g. study years, settings, population characteristics, and designs).
2. Identify research gaps in terms of the socio-demographic and health status of participants included in precision health research and how this differs across various domains, research groups, and contexts.
3. Identify how precision health has been operationalised in scientific manuscripts and patents.

Methods

The current article outlines a protocol for a scoping review that will be undertaken and reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses- Scoping Review Extension (1). In addition, guidelines set by the Joanna Briggs Institute (23) will be followed to ensure rigour and facilitate replicability of the scoping review.

Development of the Search Strategy

Our search strategy was developed using an iterative approach with two rounds of preliminary searches and refinements to the search strategy occurring in-between. Each preliminary search was deployed to two databases, Scopus and Medline, with database-specific Boolean operators applied in each. To maintain feasibility of the preliminary searches, each search was constrained to research work published in 2020.

Preliminary searches were undertaken in March and April 2020. The initial search strategy was guided by synonyms for personalized medicine identified by Brooks (24), including the following: precision, personalisation, individualisation, stratification, integrated, and tailored. Two group leaders of precision health research were also consulted to seek their feedback on the suitability of the search terms used. Permutations of the search terms were used with "health" to search for relevant articles on Scopus and PubMed. Only the titles and abstracts were searched, and only articles that were published in 2020 were included for screening. This identified a total of 253 unique abstracts. Two authors screened each abstract in independent duplicate, with the inclusion criteria being an empirical study and the exclusion criteria being a review, editorial, or perspective piece. Initial abstract screening resulted in more than 50 disagreements, which were resolved through discussion. From this initial preliminary search, it was clear that the term 'integrated' mostly captured articles that referred to integrated health systems rather than current conceptions of precision or personalised health (7, 25), and this term was therefore excluded from the next iteration of the search strategy. Furthermore, many of the irrelevant articles that were captured in earlier searches included the concepts 'precision' and 'health' but not necessarily in combination. Therefore, a further refinement to the search strategy was made such that the two search concepts are adjacent in the text.

A second preliminary search took place in the second half of April 2020, following the preliminary search. Excluding "integrated" from the search string increased the relevance of the results and resulted in 69 abstracts that were then screened. Additional details were added to the inclusion and exclusion criteria to increase agreement between reviewers (see Table 1). Following these criteria resulted in just nine disagreements, which were resolved through discussion. At this stage, the authors were satisfied that the search strategy was appropriate for the actual review.

Eligibility Criteria

Since the primary aim of the review is to provide a wide overview of precision health research, few restrictions will be placed on eligible research. Studies that were published between January 1, 2010 and the search date (June 30, 2020); describe original research or a protocol for original research that focusses on a health or medical outcome; include the terms "precision health" or its synonyms in the title or abstract; and involve human participants, samples, and/or datasets will be considered eligible (see Table 1). Studies will not be limited based on population or setting.

Table 1. Review eligibility criteria based on study population, concept, context, and types of evidence.

	Inclusion	Exclusion
Population	• Human participants of any description (e.g. adults, children, adolescents, older adults, disease populations, healthy people) • Human samples (e.g. tissue samples, genetic material). • Analysis of historical datasets (e.g. health records, epidemiological datasets).	• Evaluations of new technologies that do not include human participants (e.g. evaluating tensile properties of a new fabric, developing a new medical diagnostic kit/device without in-human testing)
Concept	• Studies that refer to the concept of precision health and its derivatives (e.g. personalised health, individualised health, stratified health, tailored health) • Any study collecting health-related clinical, psychosocial, or behavioural information (e.g. weight loss, disease prevalence/risk, physical activity, mental health)	• Animal studies, *ex vivo* studies, *in silico* studies, and testing of materials for precision health applications • Non-health outcomes including economic outcomes (e.g. cost-effectiveness studies), human performance outcomes (e.g. physical conditioning programs for healthy athletes)

Context	• Any geographical location or setting of any nature (including online studies)	• None
Types of evidence	• Primary empirical research studies, (e.g. randomised controlled trials, cohort studies, cross-sectional studies, and case reports). • Protocols for planned studies • Full-text articles • Full-text conference proceedings • Articles written in English • Patents	• Reviews (e.g. systematic reviews, narrative review) • Editorial articles (e.g. perspective pieces, position statements) • Abstracts or posters • Articles for which we cannot obtain the full-text or that are not written in English • Dissertations

Information Sources

We applied our search strategy across a number of different databases in order to retrieve potentially relevant peer-reviewed scientific reports, grey literacy, and patents. All searches were conducted on 30 June 2020. In particular, we searched for:

Peer-reviewed scientific reports: Consistent with evidence regarding optimal coverage for health and medical topics (26), Medline (through OVID), Embase, Scopus, and Web of Science databases will be searched. In addition, we will also search PsycInfo (through OVID) to capture broader applications of precision health that may pertain to well-being and mental health.

Grey literature and patents: Grey literature includes resources published outside traditional academic journals, and thus encompass government or commercial research reports, dissertations, and conference reports (27); and patents, or applications for exclusive rights to intellectual property. The inclusion of grey literature in systematic searches is considered important for establishing a balanced and complete picture of the available evidence (27). In addition, including patents is crucial in the context of precision health because innovations are occurring in the private sector, in addition to traditional academic and scientific institutions. Consistent with previous research, we searched Google Scholar to identify any relevant grey literature research reports (28) and Google Patents to identify any patents or registered intellectual property. Google Patents has broad international coverage and indexes more than 100 patent offices around the world and more than 120 million patent publications.

Finally, we will undertake hand searching of the reference lists of all included studies and of relevant reviews, as well as publication lists on websites of reputable precision health research groups.

Search Strategy and Terms

The search strategy included two concepts:

(1) "preci(sion)*" OR "personal(ised)*" OR "individual(ised)*" OR "stratif(ied)*" OR "tailor(ed)*"

(2) "health"

Search strategies were developed adapted for each database. Proximity parameters were applied such that the search concepts 'precision' and 'health' are immediately adjacent. For example, the search string for Scopus is:

(TITLE ((precision OR personali* OR individuali* OR stratif* OR tailo*) PRE/0 health) OR ABS ((precision OR personali* OR individuali* OR stratif* OR tailo*) PRE/0 health)).

The search identified a total of 8053 articles. Covidence detected and removed 4863 duplicates, leaving 3190 studies for screening.

Screening Procedure

The review will be conducted in Covidence, a web-based systematic review platform, and will occur across multiple stages. All articles obtained from the database searches will be imported into Covidence, which will remove the duplicates. A first pass of all articles will then be made based on the articles' titles alone to remove duplicates that were not detected by Covidence. For the abstract screening, 20% of the articles will be screened in independent duplicate by two members of the authorship team to gauge shared understanding of the selection criteria, discuss any disagreements, and further specify the inclusion and exclusion parameters. The remaining abstracts will then be screened individually. Any abstract where it is not clear whether the inclusion criteria are met will automatically be passed through to the full-text screening stage. For full-text screening, 10% of the articles will be screened in independent duplicate by two members of the authorship team to determine similarities and differences in the understanding of the inclusion parameters and provide clarifications if necessary. The remaining 90% of the articles will be screened individually, with each author screening articles relevant to his/her field of research (genomics, psychology, nutrition, computer science, etc.). Any discrepancies in decision or uncertainties will be resolved via discussion.

Data Charting

Data from a proportion of the articles (approximately 5%) will be extracted by two reviewers to ensure charting consistency and inter-reviewer reliability. The remaining articles will be divided and allocated between four members of the authorship team, who will then complete data charting for these articles. Similar to the full-text screening stage, articles will be allocated according to each reviewer's field of specialisation. Information on the type of precision-health related studies being performed, the country of affiliation of the authors, the authors' disciplinary affiliations, characteristics of the human participants recruited (age and health status), purpose of the study, research design, focal health issue being monitored or addressed, type of intervention (for interventional studies), and nature of the data gathered from participants will be extracted. Data charting will be conducted using a standardised Excel spreadsheet that captures these details.

We will also extract the sentence or paragraph in which the authors refer to the concept 'precision health' as qualitative data. If the concept is mentioned multiple times, we will extract the first and last mentions.

Data Synthesis

Since there are numerous research studies that self-identify with the precision health theme but may not represent it, studies will first be classified according to the extent to which they embody precision (7).

Data will be analysed and summarised descriptively, with study characteristics presented in tabular and graphical forms and summarised using a narrative approach. Research gaps will be identified through comparative analysis of study characteristics (e.g. demography of participants) to identify under-studied areas.

Qualitative data that captures the authors' reference to precision health will be subjected to thematic analysis according to Braun and Clarke's inductive-deductive approach to identify themes and commonalities in how precision health has been operationalised or co-opted as a theme or rationale for research studies (29). In reporting our results, we will highlight similarities and differences between how precision health has been operationalised in the literature and in public-facing communications of precision health research groups.

Implications

This systematic scoping review aims to provide a snapshot of the current state of human precision health research. Future directions for the field will be identified as part of the broader discussion of our results. In addition, implications of our findings for ensuring responsible innovation (16) in this research domain will be explored. Particularly, our findings could help researchers reflect more on the extent of interdisciplinarity of their work and on the efforts they are making to realise a precision health future, one that integrates individual genetic, behavioural, and environmental information for health monitoring and maintenance across the lifespan (7).

Ethics and dissemination

This study involves neither human participants nor unpublished secondary data. As such, approval from a human research ethics committee is not required. Findings of the scoping review will be disseminated through professional networks, conference presentations, and publication in a scientific journal.

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Abstract

Introduction

Precision health is a nascent field of research that would benefit from clearer operationalisation and distinction from adjacent fields like precision medicine. This clarification is necessary to enable precision health science to tackle some of the most complex and significant health problems that are faced globally. There is a pressing need to examine the progress in human precision health research in the past 10 years and analyse this data to firstly find similarities and determine discordances in how precision health is operationalised in the literature and secondly identify gaps and future directions for precision health research.

Methods and analysis

To define precision health and map research in this field, a scoping review will be undertaken and reported according to Preferred Reporting Items for Systematic Reviews and Meta-Analyses – Scoping Review Extension (PRISMA-ScR) guidelines. Systematic searches of scientific databases (Medline, Embase, Scopus, Web of Science, and PsycInfo) and grey literature sources (Google Scholar, Google Patents) identified 8053 potentially-eligible articles published from 1 January 2010 to 30 June 2020. Following removal of duplicates, a total of 8053 articles were imported for screening. Article data will be extracted using a customised extraction template on Covidence and analysed descriptively using narrative synthesis.

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Background

Supporting the health and wellbeing of a growing population, in the context of aging populations and increasingly prevalent chronic diseases, remains one of the most complex and pressing global challenges (1). Chronic diseases, such as cardiovascular disease, chronic respiratory disease, type 2 diabetes, and cancers, carry enormous social, medical, and economic burdens (2). Furthermore, the aetiology of these non-communicable diseases is largely rooted in lifestyle and environmental factors that are challenging to modify, given the nature of modern environments and occupations (3). In many countries, over-nutrition (as a primary driver of non-communicable disease) sits alongside under- and mal- nutrition within the same population (4), highlighting the complexity and 'super-wicked' nature of the global health challenges that we face (5).

Precision health is a nascent scientific discipline that is seeks to develop proactive and personalised solutions to health problems that integrate inter-individual variability in genetic, behavioural, and environmental determinants of health (6). In this way, precision health is not only about enhanced risk profiling and population stratification, but it must also encompass how that information is used to improve people's health. As an illustration of this mission, a precision health system might see health co-managed proactively by patients and health care providers through the synchronous integration of information – starting with genotyping at birth, regular screening throughout the lifespan, and combined continuous health monitoring and provision of actionable advice and early intervention at the precise moment when the individual needs it (6). A current example is the Integrated Human Microbiome Project that seeks to improve health outcomes for pre-term babies and for people with inflammatory bowel disease and/or type two diabetes through the collection and integration of longitudinal multi -omic and functional data about the host (7). In another example, scientists, through the application of machine-learning techniques to data from more than 500,000 pregnant women, developed a new predictive model for gestational diabetes mellitus that had just nine questions, representing a cost-effective condition screening tool that can significantly advance women's health (7).

Aside from these early examples, fulfilling the vision of precision health and wellbeing for all is still far from realisation. Precision health is in its infancy, having been formalised as a progeny of precision medicine only in the last decade. It is also highly multi-disciplinary, attempting to incorporate behavioural, environmental, and multi -omic information into cohesive interventions and products that are effective and person-centred. As such, one of the current challenges within precision health is its rapid growth combined with a lack of consensus on how it is defined and operationalised across multiple scientific and medical domains (8). Addressing this challenge is the focus of this scoping review.

One of the difficulties with defining or operationalising precision health is its entanglement with adjacent disciplines, particularly precision medicine, which uses advanced -omics testing to customize medical treatments based on an individual's unique biomarker profile (9). Juengst et al. (10, p. 883) referred to "*three critical rebranding episodes in contemporary genomics*: (1) the recent transition from personalised to precision medicine; (2) the ongoing transition from precision medicine to precision health; and (3) the incipient transition from precision health to wellness genomics". This ongoing transition started with efforts to conceptualise the application of human genomics to healthcare and the unconventional idea of individualising treatment and empowering patients to take more responsibility for their own health. Then, interests shifted towards giving clinicians better tools and more authority to use genomic information under the rubric of precision medicine, which in turn led to the movement's importing public health goals and expanding its scope to precision prevention at the population level (11). Reviews of early precision medicine research indicate progress towards significant advancements in medical science, such as metabolomics (particularly for drug discovery, see 10) and targeted immunotherapies to treat cancers (12). Today, the process of merging precision medicine and precision prevention in precision health is giving incipient evidence of another game-changing vision– wellness genomics, which is predicted to achieve goals beyond healthcare (10). Establishing a shared understanding of precision health and its aims is needed to realise the full potentials of precision health and wellness genomics.

Study Rationale

Over the past decade, precision health has grown quickly as a scientific discipline. However, it is still a long way away from realising its promise, which will require interdisciplinary collaboration on an unprecedented scale (8, 13). The lack of a clear definition of precision health and the interchangeable use of terms such as 'precision medicine', 'personalised health', 'precision health', and even 'precision wellness' present a major obstacle to progress in the field (13, 14). Reviewing how precision health is currently operationalised in existing literature is also needed to facilitate more responsible innovation (15) through better identification of ethical, legal, and societal concerns arising from studies tagged as precision health research (see 16, 17). Although precision and personalised medicine research have been extensively reviewed (18-21), to date, no systematic or scoping reviews of precision health research exist. In order to address this challenge, a scoping review of peer-reviewed and grey literature academic articles focusing on or mentioning "precision health" and its derivatives will be conducted.

Review Objectives

The primary objective of this scoping review is to map the current state of human precision health research, specifically to:

1. Identify how precision health is operationalised in scientific manuscripts and patents.
2. Summarise precision health research study characteristics (e.g. study settings, sample characteristics, and research designs).
3. Identify gaps in the socio-demographic and health status of participants included in precision health research and determine how these differ across various health domains and contexts.

Methods

This article outlines the protocol for a scoping review that is currently being conducted. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses- Scoping Review Extension (22) and the guidelines set by the Joanna Briggs Institute (23) are used to ensure rigour and facilitate replicability of the scoping review.

Formative work: Development of the Search Strategy

The search strategy was developed using an iterative approach, with two rounds of preliminary searches and refinement of the search strategy based on initial search results. Each preliminary search was performed in two databases, Scopus and Medline, applying database-specific Boolean operators. To maintain feasibility of the preliminary searches, each search was constrained to research published in 2020.

Preliminary searches were undertaken in March and April 2020. The initial search strategy was guided by synonyms for "personalized medicine" identified by Brooks (24), including the following: precision, personalisation, individualisation, stratification, integrated, and tailored. Two group leaders of precision health research were also consulted to gauge the suitability of the search terms. The term "precision" or its permutations were used with "health" to search for relevant articles on Scopus and PubMed. Only the titles and abstracts were searched, and only articles that were published in 2020 were included for screening. We retrieved a total of 253 unique abstracts. Two authors screened each abstract in independent duplicate, with the inclusion criterion being an empirical study and the exclusion criteria being a review, editorial, or perspective piece. Initial abstract screening resulted in more than 50 disagreements, which were resolved through discussion. From this initial preliminary search, we found that the term 'integrated' mostly captured articles that refer to integrated health systems rather than current conceptions of precision or personalised health (7, 25), and this term was therefore excluded from the next iteration of the search strategy. Furthermore, many of the irrelevant articles that were captured in earlier searches included the concepts ‘precision’ and ‘health’ but not necessarily in combination. Therefore, a further refinement to the search strategy was made such that the two search concepts are adjacent in the text.

A second preliminary search took place in the second half of April 2020. Excluding “integrated” from the search string increased the relevance of the results and resulted in 69 unique abstracts that were then screened. Additional details were added to the inclusion and exclusion criteria to increase agreement between the reviewers (see Table 1). Following these criteria resulted in just nine disagreements, which were resolved through discussion. At this stage, the authors were satisfied that the search strategy was appropriate for the actual review.

Eligibility Criteria

Eligibility criteria were established using insights from the preliminary searches. Since the primary aim of the review is to provide a wide overview of precision health research, we placed as few restrictions as possible on eligibility. Eligible studies included those that are published between January 1, 2010 (since precision health only formally distinguished itself from precision medicine after this date) and the search date (June 30, 2020); describe original research or a protocol for original research that focusses on a health or medical outcome; include the terms “precision health” or its synonyms in the title or abstract; and involve human participants, samples, and/or datasets (see Table 1). Eligible studies were not limited to a particular population or setting.

Table 1. Review eligibility criteria based on study population, concept, context, and types of evidence.

	Inclusion	Exclusion
Population	• Human participants of any description (e.g. adults, children, adolescents, older adults, populations with a particular health or medical condition, healthy people) • Human samples (e.g. tissue samples, genetic material). • Analysis of historical datasets (e.g. health records, epidemiological datasets).	• Evaluations of new technologies that do not include human participants (e.g. evaluating tensile properties of a new fabric, developing a new medical diagnostic kit/device without in-human testing)
Concept	• Studies that refer to the concept of precision health or its derivatives (e.g. personalised health, individualised health, stratified health, tailored health) • Any study collecting health-related clinical, psychosocial, or behavioural information (e.g. weight loss, disease prevalence/risk, physical activity, mental health)	• Animal studies, *in silico* studies, and testing of materials for precision health applications • Non-health outcomes including economic outcomes (e.g. cost-effectiveness studies), human/sports performance outcomes (e.g. physical conditioning programs for healthy athletes)

Context	• Any geographical location or setting of any nature (including online studies)	• None
Types of evidence	• Primary empirical research studies, (e.g. randomised controlled trials, cohort studies, cross-sectional studies, and case reports). • Protocols for planned studies • Full-text articles • Full-text conference proceedings • Articles written in English • Patents	• Reviews (e.g. systematic reviews, narrative reviews) • Editorial articles (e.g. perspective pieces, position statements) • Abstracts or posters • Articles for which we cannot obtain the full-text or that are not written in English • Dissertations

Information Sources

The search was performed across a number of databases to retrieve a wide range of potentially relevant peer-reviewed scientific reports, grey literature, and patents. All searches were conducted on 30 June 2020. In particular, we searched for:

Peer-reviewed scientific reports: Consistent with evidence regarding optimal coverage for health and medical topics (26), Medline (through OVID), Embase, Scopus, and Web of Science databases were searched. In addition, we also searched PsycInfo (through OVID) to capture broader applications of precision health that may pertain to well-being and mental health.

Grey literature and patents: Grey literature includes resources published outside traditional academic journals, and thus encompasses government or commercial research reports, dissertations, and conference reports (27); and patents, or applications for exclusive rights to intellectual property. The inclusion of grey literature in systematic searches is considered important for establishing a balanced and complete picture of the available evidence (27). In addition, including patents is crucial in the context of precision health because innovations are occurring in the private sector, in addition to traditional academic and scientific institutions. Consistent with previous research, we searched Google Scholar to identify any relevant grey literature research (28) and Google Patents to identify any patents or registered intellectual property. Google Patents has broad international coverage and indexes more than 100 patent offices around the world and more than 120 million patent applications.

We also undertook hand searching of the reference lists of relevant primary studies and reviews, as well as publications on websites of precision health research groups.

Search Strategy and Terms

The search terms included two concepts:

(1) “preci(sion)*” OR “personal(ised)*” OR “individual(ised)*” OR “stratif(ied)*” OR “tailor(ed)*” AND

(2) “health”

Search terms were adapted for each database with proximity parameters applied such that the concepts ‘precision’ and ‘health’ are immediately adjacent. For example, the search string for Scopus was:

(TITLE ((precision OR personali* OR individuali* OR stratif* OR tailo*) PRE/0 health) OR ABS ((precision OR personali* OR individuali* OR stratif* OR tailo*) PRE/0 health)).

The search identified a total of 8053 articles. Covidence detected and removed 4863 duplicates, leaving 3190 studies for screening.

Screening Procedure

The review is being conducted in Covidence, a web-based systematic review platform, in four stages. In stage one, all articles obtained from the database searches were imported into Covidence, and the platform was used to detect and remove duplicates. In stage two, we checked all the remaining article titles to remove duplicates that were not detected by Covidence. In stage three, all article abstracts were screened in independent duplicate to gauge shared understanding of the selection criteria, discuss any disagreements, and further specify the inclusion and exclusion parameters. Any abstract where it is not clear whether the inclusion criteria are met was automatically passed through to the full-text screening stage.

Stage four, which involves independent duplicate screening of all full-texts, is currently underway. In addition to the article eligibility criteria in Table 1, we have also decided to exclude articles that only use the search terms in the abstract, discussion, and/or conclusion. Only including articles that also mention the search terms in the introduction, methods, and/or results allows us to focus on articles that are primarily positioned as precision, personalised, individualised, stratified, or tailored health. In stage four, discrepancies in the inclusion or exclusion decision are resolved through discussion.

Data Charting

The next stage in the review process is data charting (to be commenced). Data from all included articles will be extracted in independent duplicate to ensure charting consistency and inter-reviewer reliability. We plan to extract information on the type of study, country or countries of affiliation of the authors, authors’ disciplinary affiliations, characteristics of the human participants recruited (age and health status), purpose of the study, research design and setting, focal health issue being monitored or addressed, type of intervention (for interventional studies), and nature of the data gathered from participants. Data charting will be conducted using Covidence.

We will also extract as qualitative data the sentence in which the authors refer to the concept 'precision health' or its derivatives. If the concept is mentioned multiple times, we will extract the sentence that best defines the concept.

Data Synthesis

Data will be analysed and summarised descriptively, with study characteristics presented in tabular and graphical forms and summarised in the text using a narrative approach. Research gaps will be identified through comparative analysis of study and participant characteristics.

Qualitative data that capture the authors' reference to precision health will be subjected to thematic analysis according to Braun and Clarke's inductive-deductive approach to identify themes and commonalities in how precision health is operationalised or co-opted as a theme or rationale for research studies (29). In reporting our results, we will also highlight similarities and differences in how precision health is operationalised in the academic literature.

Ethics and Dissemination

This study involves neither human participants nor unpublished secondary data. As such, approval from a human research ethics committee is not required. Findings of the scoping review will be disseminated through professional networks, conference presentations, and publication in a scientific journal.

Patient and Public Involvement

This work analyses existing research studies and therefore involves no patients or members of the public.

Implications

This scoping review aims to provide a snapshot of the current state of human precision health research. Future directions for the field will be identified as part of the broader discussion of our results. In addition, implications of our findings for ensuring responsible innovation (16) in this research domain will be explored. Particularly, our findings could help researchers reflect more on the extent of interdisciplinarity of their work and on the efforts they are making to realise an equitable precision health future, one that integrates individual genetic, behavioural, and environmental information for health monitoring and maintenance across the lifespan (7).

Contributorship Statement

JCR & JNMV led the conceptualisation and design of this work. JCR, JNMV, HS, SVG, and NOC each made substantial contributions to the drafting and critical revision of the work and all authors approved the final manuscript.

Competing interests

The authors have no competing interests to report.

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