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Digital Health for Myocardial Infarction: Research Topics and Trends

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Abstract. We aimed to map the topics and trends of research on digital health for myocardial infarction over the past ten years. This can inform future research directions and newly emerging topics for myocardial infarction care, diagnosis and monitoring. The Web of Science database was searched for papers related to digital health for myocardial infarction. 1,344 retrieved records were used for visualisation through bibliometrics and co-occurrence network analysis of keywords. Our mapping revealed several emerging topics in recent years, including artificial intelligence and deep learning. Higher emphasis on automated and artificially intelligent digital health systems in recent years can inform future clinical practice and research directions for myocardial infarction.

Keywords. Artificial intelligence, chronic care management, data visualisation, digital health

1. Introduction

Myocardial infarction (MI) is a serious and life-threatening condition. Hospitals and health providers often will not have the resources or initiatives available to facilitate the transition from hospital to home [1]. Secondary prevention may allow for greater patient care to prevent MI [1]. Secondary prevention strategies can be delivered as digital health interventions. Recent technological advancements in digital health, such as the rise of tailored and adaptive interventions for each user, means there are more opportunities than ever for digital health to support patients with MI [2]. This study will focus on using digital health to improve MI outcomes.

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Digital health is defined as an array of novel digital technologies used to support health using data about lifestyles, habits, clinical histories and pathophysiological characteristics [3]. Digital health is applicable across various health issues, such as supporting the care of MI patients; a field that has become relatively prominent in digital health research [2]. Digital health technologies may guide a person at risk of experiencing an MI to change key lifestyle behaviours, i.e., smoking cessation, to reduce the likelihood of a future MI [2]. They support the care of MI patients in a timely, efficacious, and cost-efficient manner [4,5]. Digital health can reduce readmission of heart failure patients with daily remote monitoring [6] and increase MI drug adherence and satisfaction [7].

Several studies have reviewed the use of digital health in cardiovascular diseases. The majority of these review studies aimed either to assess the efficacy of digital health interventions for cardiovascular care through a systematic review [5,8] or to explore the functions and features of mobile apps for cardiovascular health [9]. Few studies, if any, have endeavoured to present a holistic perspective of the spectrum of digital technologies being used for cardiovascular diseases. This study aims to identify and visualise the hot topics and trends of research in digital health for MI. Network analysis will identify country and journal publication trends in this interdisciplinary field.

2. Methods

We conducted a bibliometric analysis on publications in the past ten years using VOSviewer version 1.6.16 [10]. We searched the Web of Science Core Collection for digital health for MI research. Three relevant databases were searched: Science Citation Index Expanded, Social Sciences Citation Index and Emerging Sources Citation Index. The search strategy involves 1. "digital health" (with similar keywords separated by OR), 2. "myocardial infarction" OR "heart attack", 3. "telecardiology" OR "tele-ECG", 4. (#1 AND #2) OR #3, Timespan: 2011-2021, Language: English.

Full records and cited references were exported into VOSviewer. We merged multiple synonymous keywords into one encompassing keyword using a thesaurus file. This ensured keywords were formatted in the same manner, making results more interpretable with less repetition, e.g., 'mobile health' and 'm-health' were merged into 'mHealth'. We ignored general and irrelevant terms, such as 'results' and 'conclusion', and all redundant clinical terms, such as 'heart attack' and 'acute coronary syndrome', as these keywords are not informative and would lead to diminished visualisation capacity. Two visualisations were created through co-occurrence analysis of keywords: Network Visualisation (nodes are grouped as clusters) and Overlay Visualisation (the colour of nodes is determined by an average score attribute). The more articles published on a keyword, the bigger the label and the larger the node. The colour of each node denotes its cluster and a longer distance between nodes denotes less connection between topics.

3. Results

Our search in the Web of Science database provided 1,344 records. Visualisations that represent connections between research keywords and emerging topics in the literature were created. Supplementary figures can be viewed here: https://osf.io/px9na/

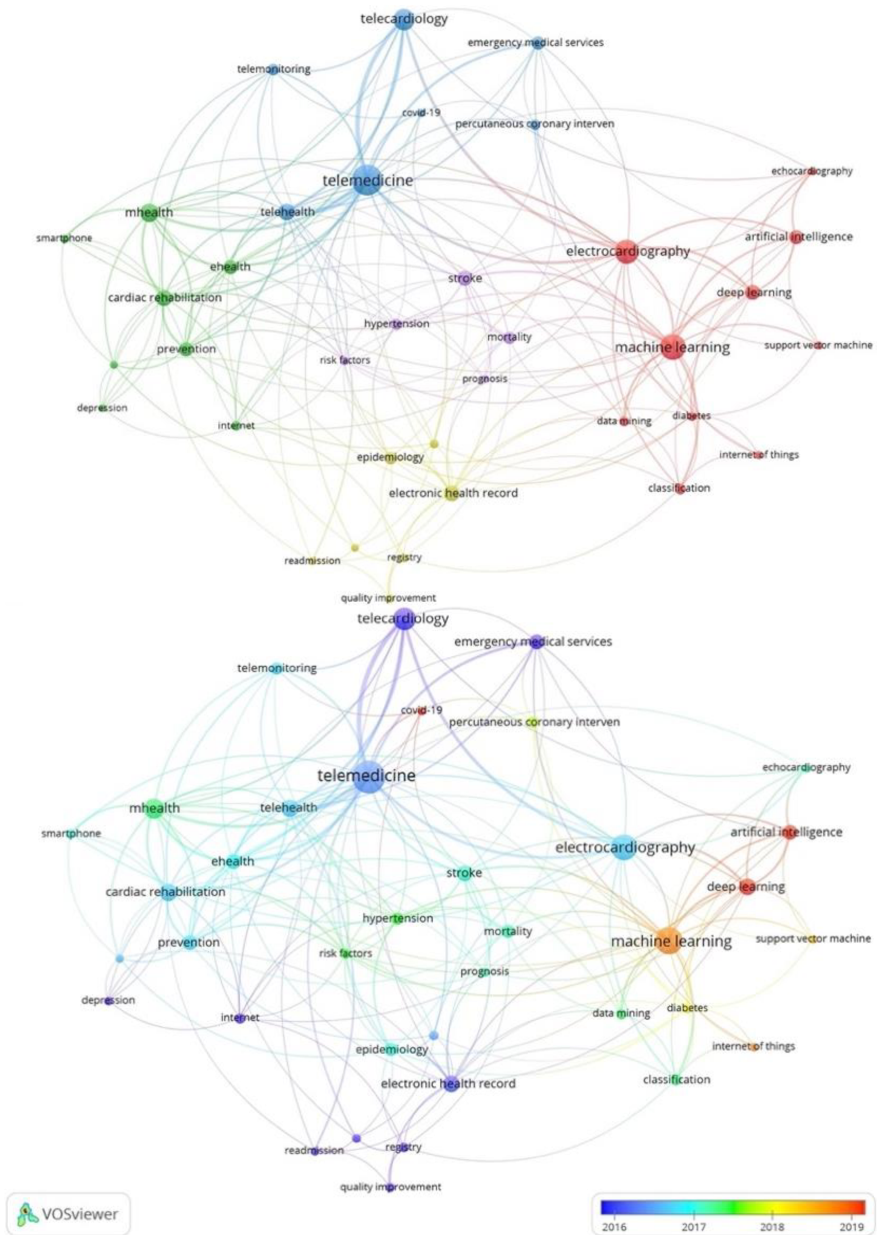

Figure 1. Top: Network visualisation of research topics in digital health for myocardial infarction using co-occurrence analysis of keywords. Bottom: Same as the top image but based on the average year of publication.

3.1. Publication trend, country analysis and journal analysis

There is an upwards trend in published research (2012 < 100 publications; 2020 > 300 publications). The greatest contributor to this field is the USA; however, their average contribution was not made recently. Other sizable contributions are from the People's

Republic of China, England and Germany. The most recent average contributions to this field are from Saudi Arabia, Norway, Sweden, Iran and Pakistan. The USA has the most collaboration with multiple countries. Journals that have recently contributed to this research field are IEEE Access and BMJ Open. Other sizable contributors are Circulation, Journal of the American College of Cardiology, and Telemedicine and E-health.

3.2. Research topics and emerging topics

Our analysis of the co-occurrence of research topics revealed five clusters, which are depicted in Figure 1. These clusters encompass: 1) telemedicine; 2) artificial intelligence (AI); 3) mobile health; 4) electronic health record; and 5) health and wellbeing. Figure 1 also depicts average changes in MI and digital health research. The average number of publications for keywords over 10 years occurred between 2016-2019. 'Artificial intelligence', 'deep learning' and 'covid-19' are the most recently merging research topics, followed by 'machine learning' and 'support vector machine'.

4. Discussion

We have mapped the topics and trends of research on digital health for MI. Researchers may benefit from following publications from identified countries and journals that have a keen interest and investment in MI and digital health. We have identified the AI cluster to be the most recently emerging topic, particularly 'AI' and 'deep learning' research. Researchers can use this to identify current research trends to inform possible expansions in their studies. For instance, researchers in comorbid MI and diabetes space may look at machine learning as a novel solution due to its proximity to the diabetes node. Alternatively, the AI cluster has relatively few connections with the mHealth and eHealth clusters which could prompt researchers to study AI use in mHealth and eHealth to fill this research gap.

A bibliometric analysis of mobile health applications has depicted four of five primary clusters similar to our findings [11]: 1) mobile health apps in telemedicine, chronic disease and medication adherence management (telemedicine cluster); 2) the technology and system development of mobile health apps (AI cluster); 3) mobile health apps in health behaviour and health promotion (health and wellbeing cluster); and 4) mobile health apps in disease prevention via the internet (mHealth cluster). This verifies our representation of the research, while our review specifies MI topics, e.g., 'deep learning'. The rise in AI coincides with research reporting a 45.15% increase in healthcare AI research from 2014-2019, with heart failure identified as a primary health issue in AI [12]. Connections between topics can guide clinicians, e.g., clinicians using electrocardiography can investigate proximal, closely related connections, such as machine learning. This indicates there is research applying machine learning and deep learning with electrocardiography. This review also informs researchers and industry partners of emerging topics that may be profitable, such as 'AI' and 'deep learning'.

This review shows the AI cluster is not well connected to 'mHealth' and 'eHealth' in the MI literature; however, there may be practical benefits to using AI. An application can learn user patterns to determine optimal intervention delivery. Then, machine learning from the AI cluster can adapt to these patterns to deliver the intervention at the optimal time and intensity to support optimal health behaviours. Therefore, our research exposes a gap to explore in future research, leading to the creation of future novel mHealth.

This review has limitations. Without published research detailing the digital health targeting MI, these products and services cannot be reflected in this review. Additionally, advocacy for research topics was not captured, e.g., research criticising AI would feature in the AI cluster. Readers should use this review primarily to identify research topics.

5. Conclusions

In recent years, key research areas relating to AI and deep learning are gaining traction in the MI and digital health space. The AI cluster is minimally associated to mHealth and eHealth research, presenting a gap that should be investigated.

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