Promises of AI-assisted Patient Monitoring Methods

Barbier S[1], Hasni M[2], Aroui K[2], Tournier C[1], Wojciechowski P[3], François C[1], Toumi M[4], Bakhutashvili A[5]
[1]Creativ-Ceutical, France, [2]Creativ-Ceutical, Tunisia, [3]Creativ-Ceutical, Poland, [4]Aix-Marseille University, France, [5]MARCO POLO, Luxembourg

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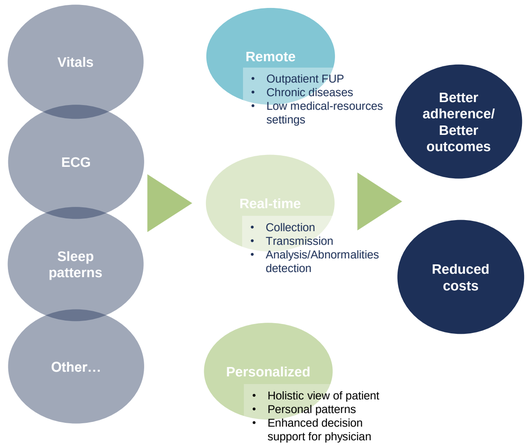
OBJECTIVES

Accurate monitoring is paramount for proper care strategy and timely intervention. The development of efficient, portable and connected sensors allows for the remote and potentially real-time monitoring of patients, in the context of clinical trials or in routine practice. AI methods applied on those data have the potential to detect abnormalities and recognize personalized patterns. Our aim was to review existing the AI solutions and evaluate their usefulness.



METHODS

- A search strategy was implemented in MEDLINE and EMBASE via OVID, based on a previously developed search filter for AI, by Liu et al. 2021, and covering the period from 1st January 2020 to 1st December 2021.
- Both titles and abstracts were screened. It was completed by a grey literature search on specialized media, relevant conferences websites, providers websites and research reports.

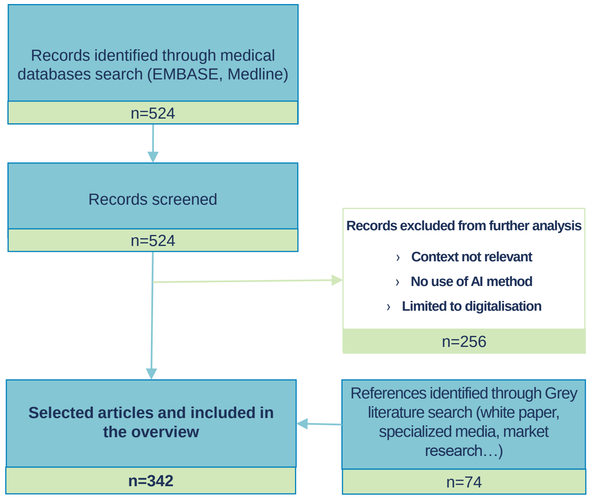
Table 1. PICOS

PICOS	Inclusion and exclusion criteria
Population	No restriction
Interventions & Comparators	No restriction
Outcomes	No restriction
Study design/type	**Inclusions:** • Methodology papers • Case studies • Use of AI in the study methods (explicitly reported in the study abstract) **Exclusions:** • Digital application without AI support
Other restrictions	Time restriction: Search was limited to studies published 1.1.2020 - 1.12.2021 to get the overview of the current status of development and use of AI methods. Language: English Search limited to Human studies

Figure 1. Combined keywords for the search

Patient Digital Services		AI studies
"patient" and ("monitoring" or "compliance")	+	Artificial intelligence
		Machine learning, deep learning, reinforcement learning
"eHealth" or "eHealth" or "Digital health intervention" or "DHIs" or "Digital services		Learning algorithm$
		Neural networks
		Natural language processing
		Expert system$, intelligent agent$
		Supervised learning, unsupervised learning

Figure 2. Selection



RESULTS

- The search yields 524 hits and 268 articles were selected after screening. Additionally, 74 publications from grey literature were reviewed and included.
- AI-assisted monitoring solutions span over signal processing technics, smart display via dynamic and enriched dashboards, consolidation of narratives extracted from medical reports, pattern recognition and prediction of adverse events. They could be applied in hospital settings with the connection to specialized biomedical measurement tools, or could rely on simple portable sensors and used on the everyday life for remote monitoring following an medical event, or monitoring of chronical diseases.
- In most published studies in theoretical settings, AI methods outperformed classical approaches, but the applications in real-life settings are less accurate than expected. Medical situations are complex and AI are not able yet to cover the wide range of unexpected events and status that could be encountered.
- They offer the advantages of providing good results in remote settings, with long-term and personalized follow-up, even with off-the-shelf devices. Unfortunately, they are limited by the currently modest size of the training datasets, and the need for highly customized algorithms for each medical condition or setting.
- Health care providers may be hesitant to rely on AI monitoring for acute events, because of unsatisfactory experience in real-life setting. But accuracy of the prediction is expected to improve as the quantity, quality, precision and diversity of available data increase. And as the method gets more reliable, acceptance by caregivers should increase, leading to more timely intervention, patients' empowerment and eventually better outcomes.

CONCLUSIONS

The refinement of AI algorithms and increased power and precision of hardware can help improving clinical measurements and outcomes with comprehensive, remote and real-time monitoring.

Several solutions are already giving satisfying results and are getting a wider audience in real-life setting. There is a large pipeline of promising solutions developed in academia that still need to be further assessed.

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