

HOW IS MACHINE LEARNING BEING USED IN HEOR? A SYSTEMATIC REVIEW OF TRENDS AND METHODS

Carol Kirshner¹, Selin Merdan¹, Melisa Erdogan², Melissa Lydston⁴, Turgay Ayer^{1,3}, Jag Chhatwal^{1,4}

¹Value Analytics Labs, Boston, MA, USA, ²Istanbul Technical University, Istanbul, Turkey, ³Georgia Institute of Technology, Georgia & Emory Medical School, Atlanta, GA, USA, ⁴Massachusetts General Hospital Institute for Technology Assessment, Harvard Medical School, Boston, MA, USA

OBJECTIVES

- The inclusion of machine learning based approaches in healthcare applications has increased at a rapid pace over the past years; however, there is limited understanding of how machine learning intersects with health economics and outcomes research (HEOR).
- The objective of this study was to conduct a systematic review of machine learning and HEOR to understand the intersection of the two fields, identify trends, and suggest future directions.

METHODS

- A systematic search was conducted in Medline and Embase databases for the period between January 2004 and September 2021. Inclusion and Exclusion criteria are detailed in Table 1.
- Title and abstract screening were performed by two independent reviewers per PRISMA guidelines. Ties were broken by a third independent reviewer. The text of included studies mentioned both ML and cost-effectiveness/health economics.
- The search strategy incorporated controlled vocabulary and free-text synonyms for the concepts of artificial intelligence, health economics or healthcare costs, and analysis. A date limit was applied limiting to articles published after the year 2004.

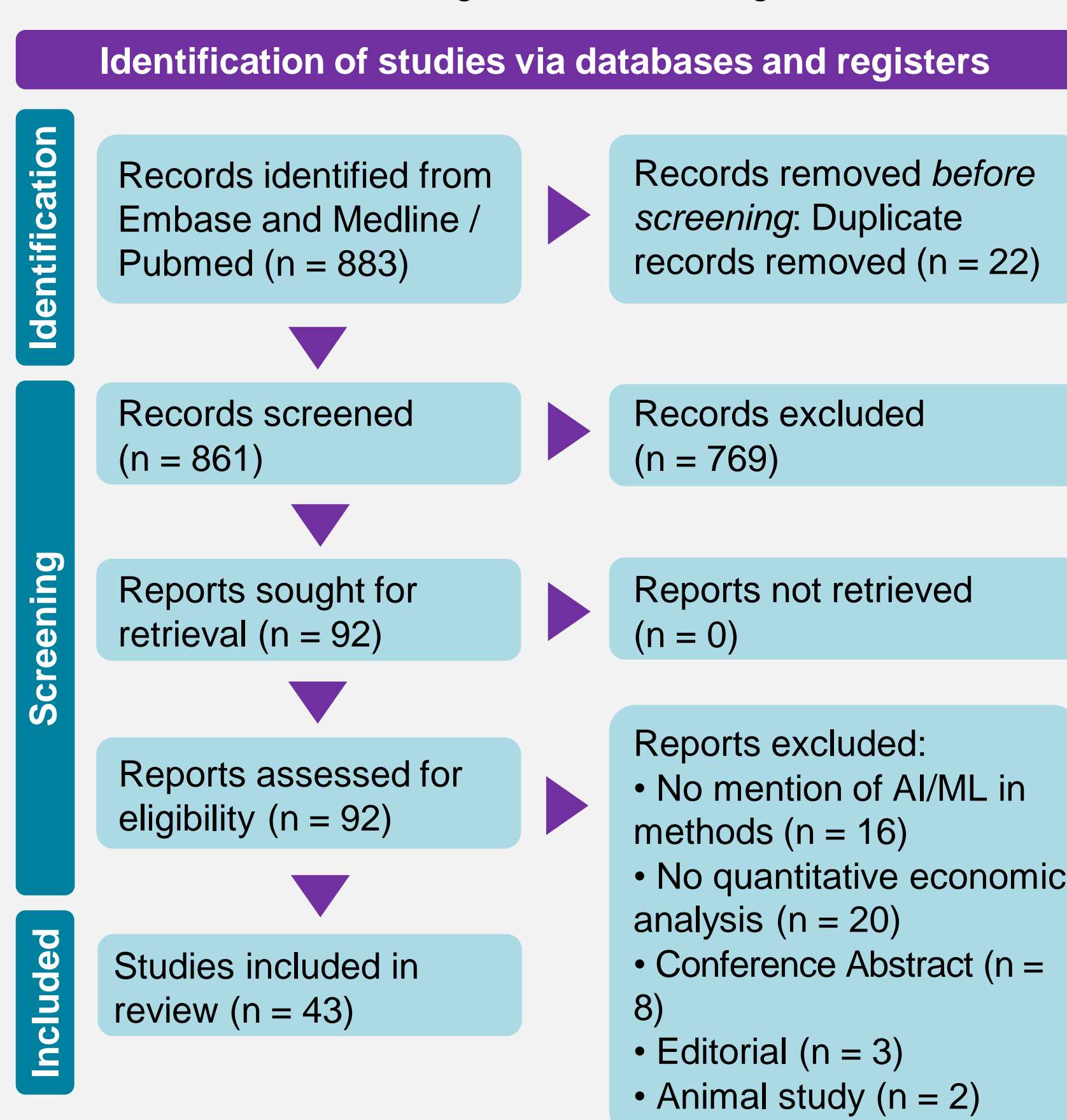
Table 1: Inclusion and exclusion criteria.

Inclusion Criteria	Exclusion Criteria
English Language	Animal studies
Peer-Reviewed	Non-English publications
Full articles	The full-text methods section of the publication does not include a description of a machine learning process.
Healthcare setting	The abstract or full text does not elaborate on the quantitative economic outcome of a machine learning process.
Healthcare setting	Systematic Review
Healthcare setting	Conference abstracts, posters, or preprints

RESULTS

Of the 861 articles screened, 43 articles were included in the review. A flow diagram of records found, screened, selected, and excluded with the corresponding exclusion criteria is shown in Figure 1.

Figure 1: PRISMA flowchart describing study selection and reasons for exclusion during full-text screening.



KEY FINDINGS

1 Machine learning has the potential to influence HEOR, but the current applications remain limited in scope and depth.

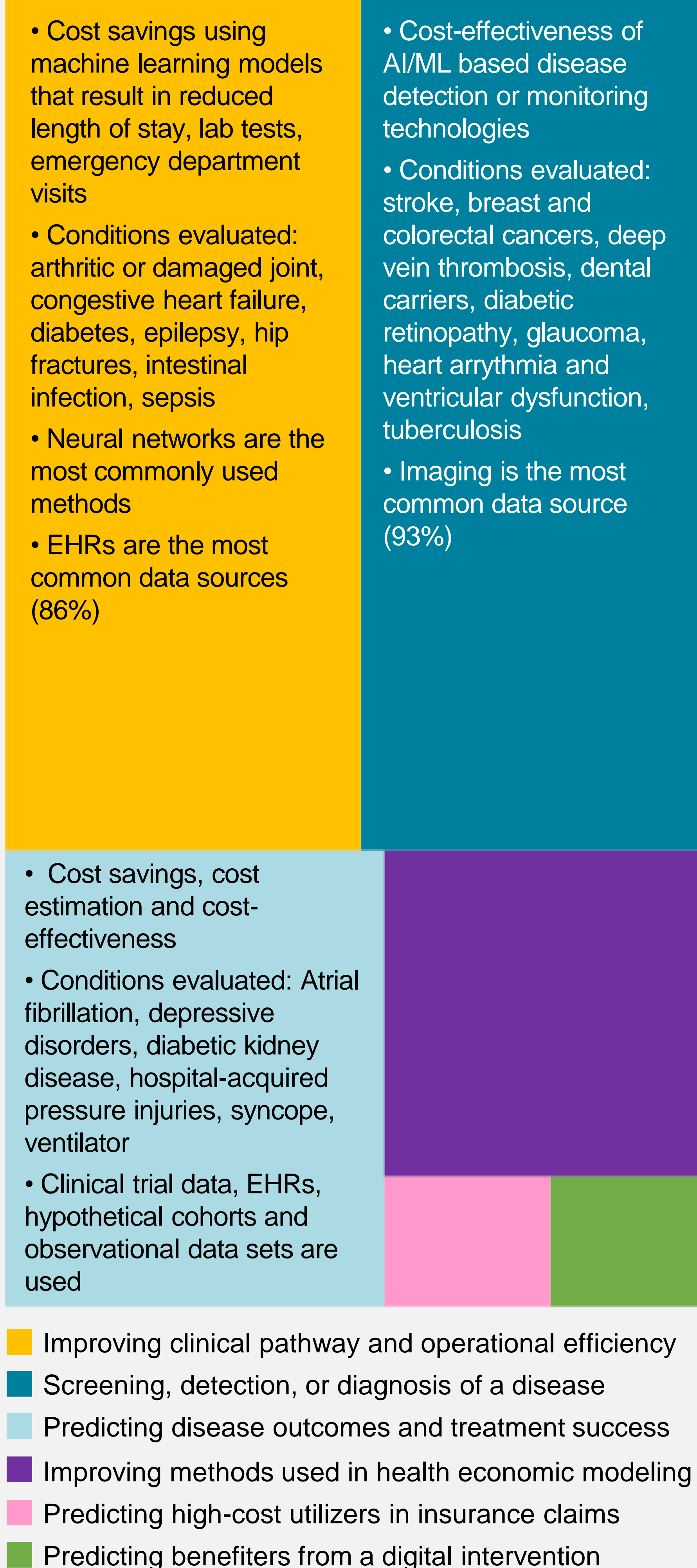
2 Future studies should explore the role of digital interventions, wearable technologies, and social media data in HEOR.

3 Our review did not find any HEOR study on emerging machine learning technologies such as Generative AI that uses self-supervised learning to generate human-like text.

RESULTS (cont.)

The included articles fell into six major categories: 1) improving clinical pathway and operational efficiency (33%), 2) predicting disease outcomes and treatment success (19%), 3) screening, detection, or diagnosis of a disease (33%), 4) predicting high-cost utilizers using insurance claims (2%), 5) improving methods used in health economic modeling (12%), and 6) predicting who will benefit from a digital intervention (2%). (Figure 2)

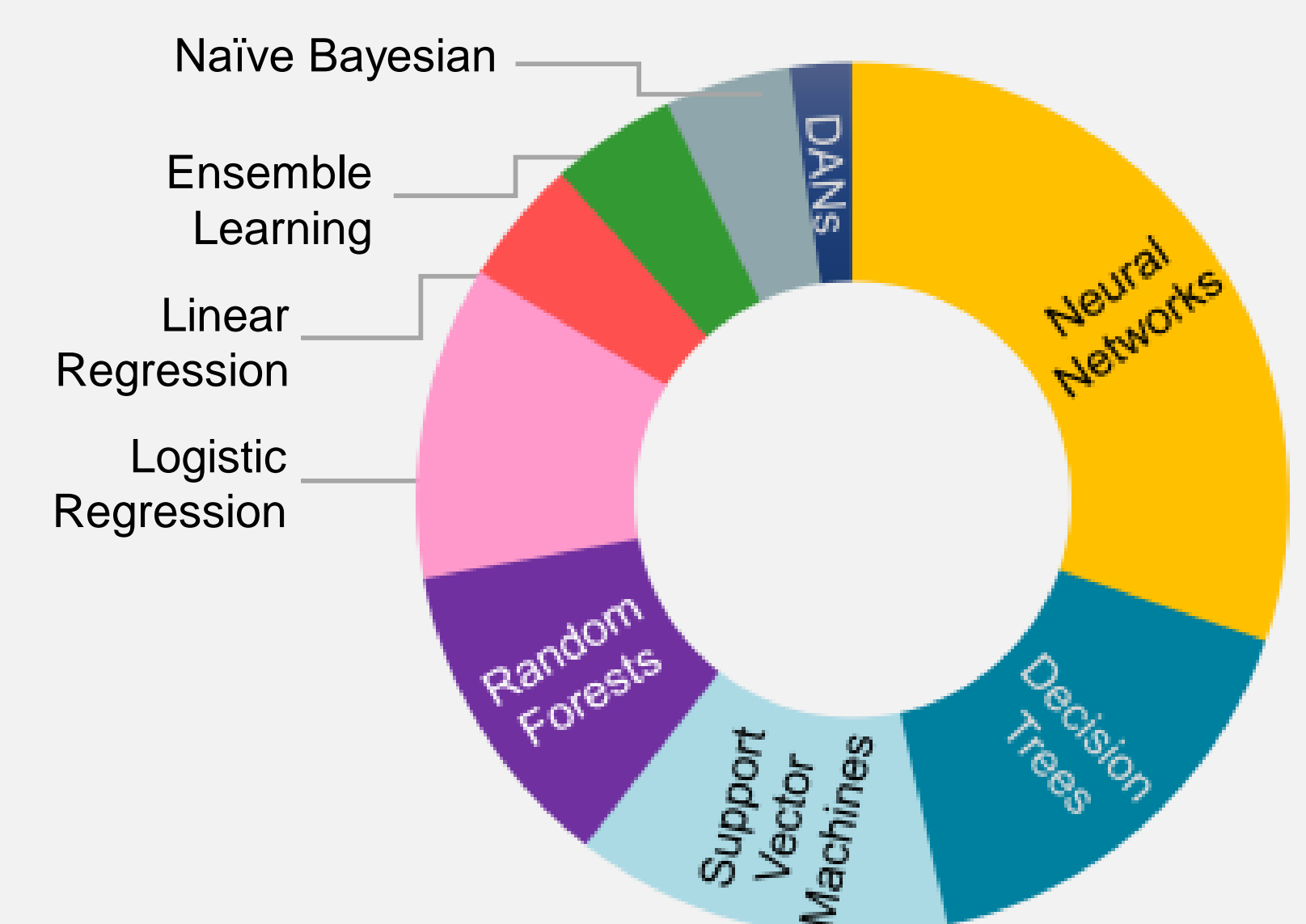
Figure 2: General overview of the types of AI/ML applications.



RESULTS (cont.)

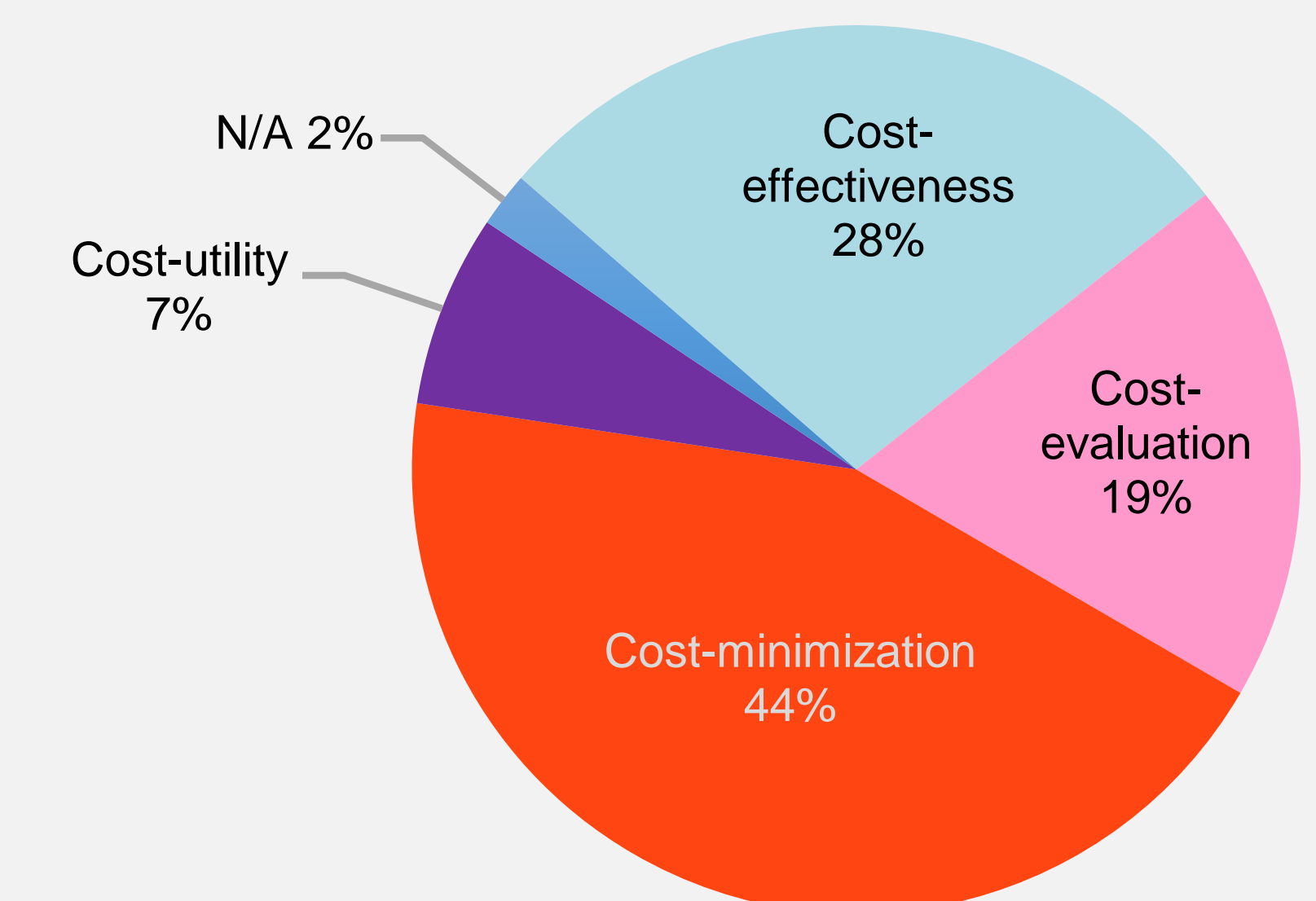
Neural networks, Decision trees and Support Vector Machines were the most commonly utilized machine learning algorithm. (Figure 3)

Figure 3: Overview of the AI/ML algorithms used in the included studies.



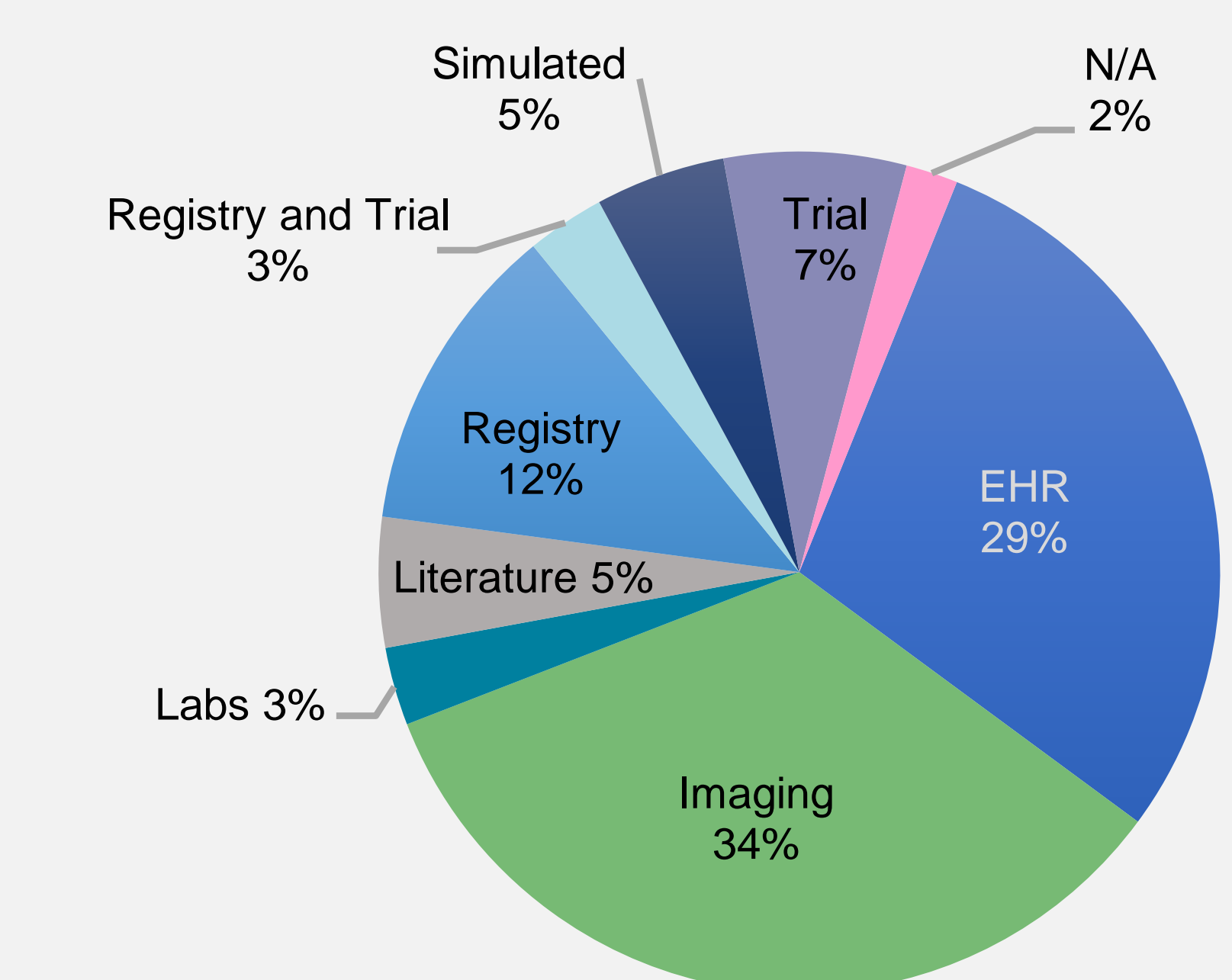
The primary health economic analyses were cost-effectiveness and cost-minimization (72% of all). (Figure 4)

Figure 4: Overview of the types of health economic evaluation methods used in the included studies.



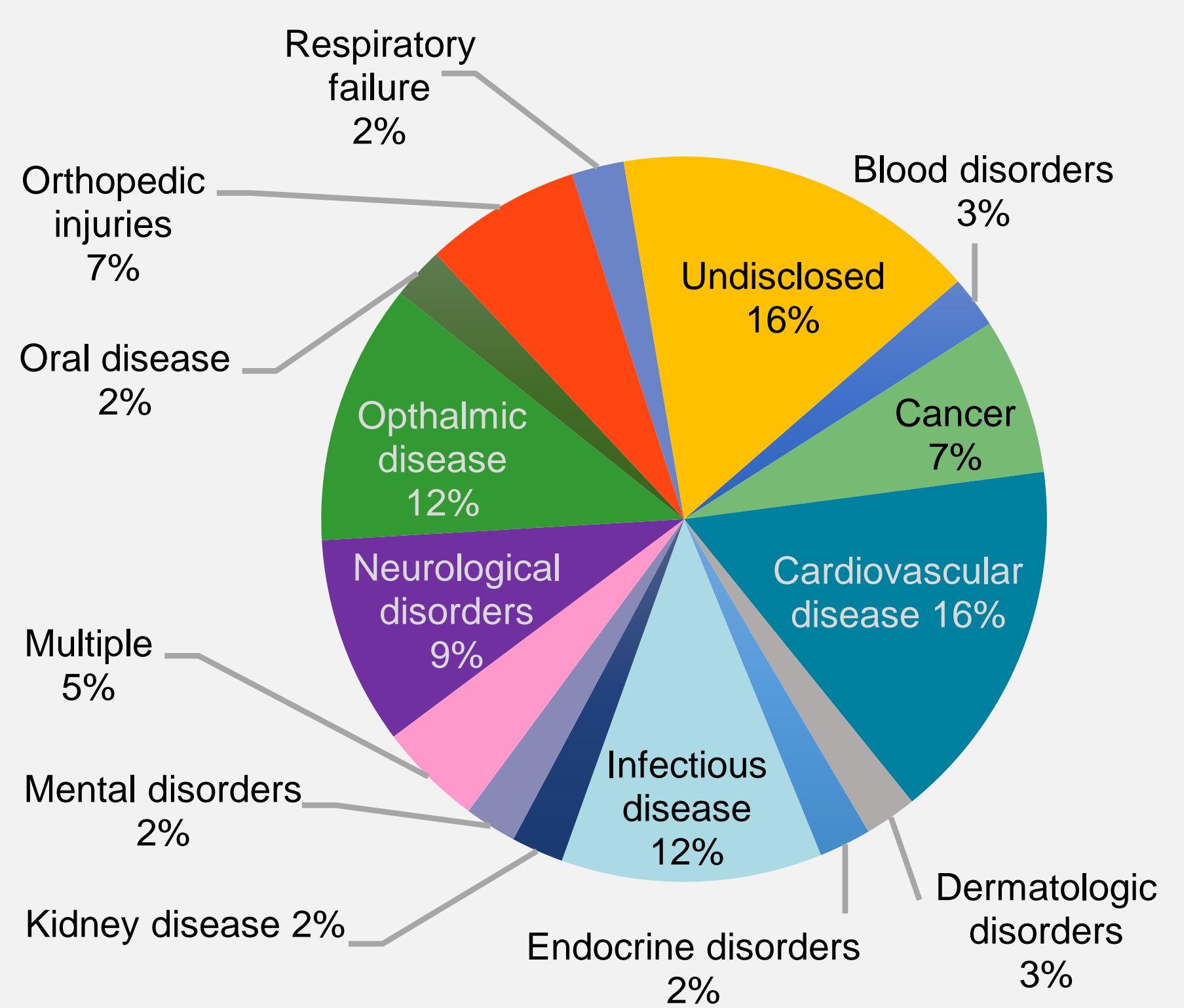
The majority of data sources were Electronic Health Records (EHRs) and imaging (63% of all). (Figure 5)

Figure 5: Overview of the types of data sources used in the included studies.



The studies were conducted in a range of disease fields with cardiovascular, ophthalmic, and infectious disease being the dominant fields. (Figure 6)

Figure 6: Overview of the disease fields the included studies were conducted in.



Contact: CKirshner@valueanalyticslabs.com