The impact of electronic health records on healthcare quality: a systematic review and meta-analysis.

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"An electronic health record (EHR) is a systematic electronic collection of health information about patients such as medical history, medication orders, vital signs, laboratory results, radiology reports, and physician and nurse notes. In healthcare institutions, it automates the medication, as well as exam, ordering process ensuring standardized, readable and complete orders" (Campanella et al., 2015). For safe and effective care, reliable access to comprehensive patient health information is critical. EHRs offer clinicians with accurate and full information about a patient's health and medical history. Providers can deliver the best possible treatment at the point of care with EHRs. This may result in a more positive patient experience and, most importantly, improved patient outcomes.

The primary author of this article is Paolo Campanella Department of Public Health, Catholic University of Sacred Heart, L.go F. Vito 1 00168, Rome, Italy, has mentioned - Although several studies on the effects of EHR implementation have been published, evidence on EHR effects continues to be disputed. Even if most of the studies published seem to provide promising data, some reported different results. To assess the impact of EHRs on healthcare quality, we hence carried out a systematic review and meta-analysis of published studies on this topic that may provide a rational basis for recommendations.

How the research was conducted

The databases PubMed, Web of Knowledge, Scopus, and the Cochrane Library were searched for research that looked at the relationship between EHR deployment and process or outcome indicators. According to the PRISMA criteria, two reviewers evaluated identified citations and collected data. "A protocol was developed, and we searched in PubMed, Web of Knowledge, Scopus and Cochrane Library databases to identify studies that evaluated the benefits of EHR implementation using the following algorithm:

- #1 = 'Electronic Medical Record' OR 'Electronic Health Record' OR 'Electronic Patient Record'.
- #2 = 'Computerized Physician Order Entry'.
- #3 = 'Decision Support Systems'.
- #4 = #1 OR #2 OR #3.
- #5 = value OR impact OR benefit OR improvement.
- #6 = quality OR efficiency OR risk OR safety.
- #7 = #5 OR #6.
- #8 = #4 AND #7." (Campanella et al., 2015)

The scope of the search was limited to English language research published between 1994 and 2013. Titles were examined by one reviewer, and then relevant title abstracts were found. Two reviewers did all data extractions independently, and disputes were addressed through discussion. "For indicators represented by dichotomous variables, risk ratios (RRs) with their confidence intervals (CIs) (or data necessary to obtain them) were extracted. For indicators represented by continuous variables, sample sizes of both control and intervention groups and

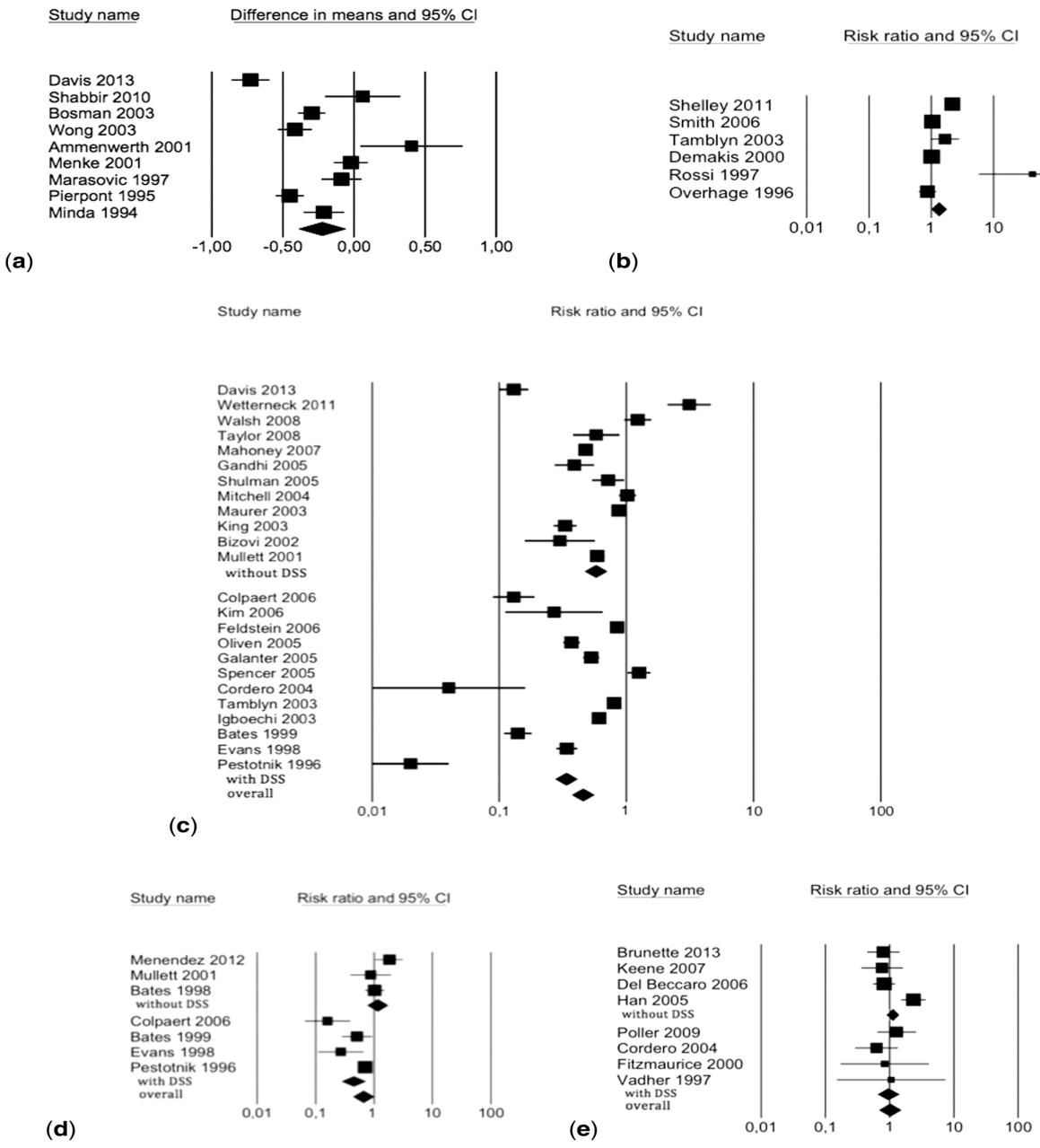
differences in mean (DMs) and their CIs (or data necessary to obtain them) were extracted."

(Campanella et al., 2015)

Collected Data, Analysis, and Results

Each process or result indicator was subjected to a meta-analysis. Sensitivity analyses were carried out by removing one study from the meta-analysis at a time to see if the results of the meta-analysis were changed by individual studies and if risk estimates and heterogeneity were significantly altered.

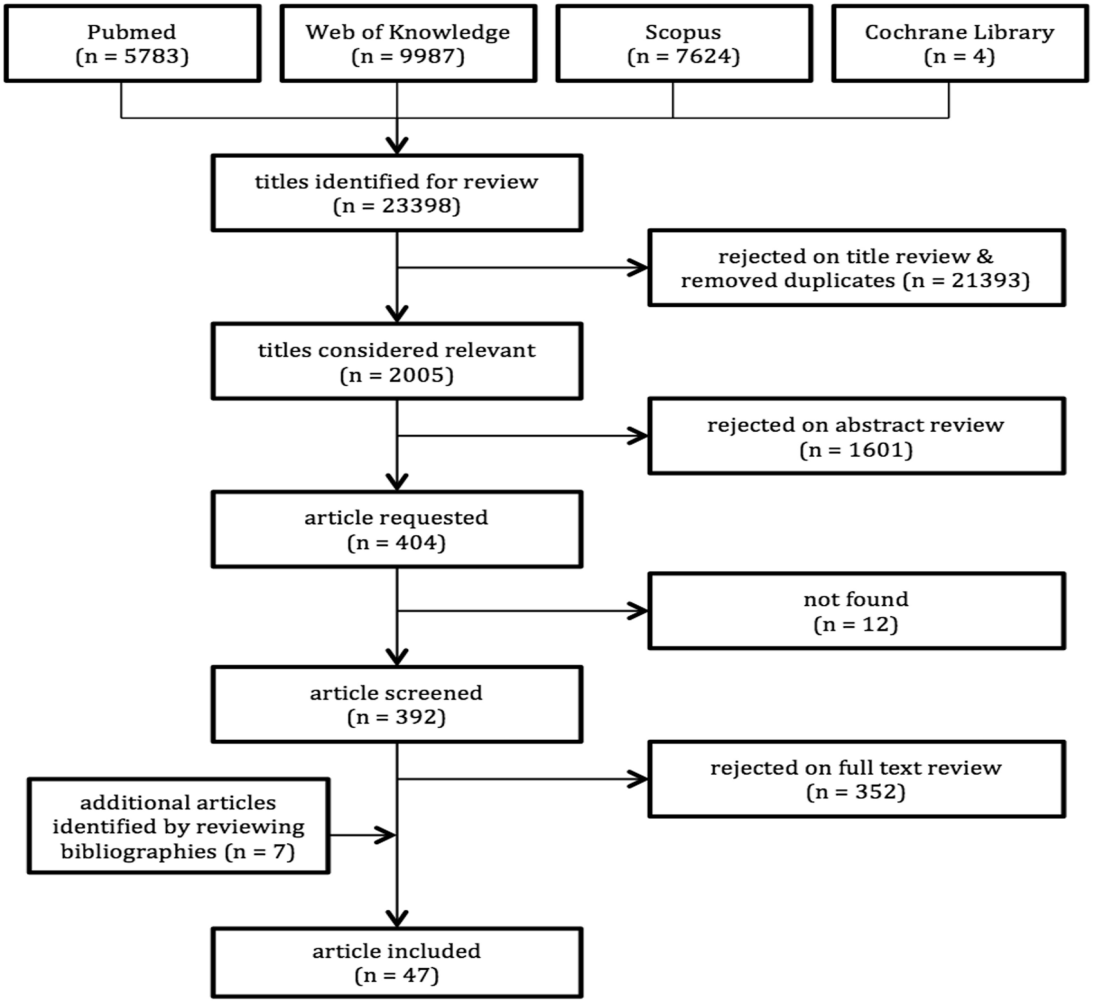
All statistical tests were performed with Comprehensive Meta-Analysis software version 2.2.064 (Biostat, Englewood, NJ). “Heterogeneity was quantified using the Cochran Q test and I statistics. For indicators with available both studies including DSS and not subgroup analyzes were performed. Meta-analysis showed an association between EHR use by healthcare professionals and a reduced documentation time with a difference in mean of −22.4% (95% CI = −38.8% to −6.0%; $P < 0.007$). The EHR resulted also associated with a higher guideline adherence with an RR of 1.33 (95% CI = 1.01 to 1.76; $P = 0.049$) and a lower number of medication errors with an overall RR of 0.46 (95% CI = 0.38 to 0.55; $P < 0.001$) and ADEs with an overall RR of 0.66 (95% CI = 0.44 to 0.99; $P = 0.045$). No association with mortality was evident ($P = 0.936$).” Subgroup analysis confirmed the association between EHR and a reduction of medication errors and showed a better outcome for EHR including DSS, RR of 0.33 (95% CI = 0.25 to 0.45), compared with software without DSS, RR of 0.60 (95% CI = 0.45 to 0.81). Moreover, regarding the absence of significant association between EHR and mortality, subgroup analysis confirmed this absence with a slightly better outcome for EHR using DSS, RR of 0.93 (95% CI = 0.58 to 1.49), compared with EHR not using DSS, RR of 1.06 (95% CI = 0.59 to 1.92). (Campanella et al., 2015).



Forest plot for the meta-analysis of studies reporting on (**a**) EHR and documentation time, (**b**) guideline adherence, (**c**) medication errors, (**d**) ADEs and (**e**) mortality. The overall, as well as subgroup, estimates of the effect are represented by diamonds in each plot

The online databases PubMed, Web of Knowledge, Scopus, and the Cochrane Library yielded 23 398 articles. 404 articles were chosen for full text review after an initial screening of titles and abstracts. Twelve articles were omitted because complete texts were unavailable, and

352 were omitted after a full text assessment. After analyzing bibliographies, seven more papers were found, bringing the total number of articles in the study to 47.



Conclusion

The meta-analysis shows that using an EHR can enhance healthcare quality by boosting time efficiency and adherence to guidelines, as well as lowering prescription mistakes and adverse events. As a result, EHR can indicate a reduction in expenses connected with medical mistakes, adverse drug events, and inefficient time management. As several instances described in scientific literature, adherence to guidelines may have an influence on resource utilization and cost reduction, assisting experts in their clinical decisions by minimizing mistakes and ADEs connected to treatment and, as a result, wasteful waste of resources. In reality, recommendations are touted as a way to reduce medical mistakes, as well as improper clinical practice variability and the use of ineffective medications, leading in better patient outcomes and more cost-effective care.

Regardless of the advantages that EHR might give, a suitable implementation approach is required. In our opinion, there are likely to be occasions when the success of EHR is hampered by ineffective implementation strategies. EHR systems have been shown to enhance healthcare quality by boosting time efficiency and adherence to guidelines, as well as lowering medication mistakes and adverse drug events (ADEs). As a result, EHR implementation tactics should be encouraged and pushed. “Subgroup analyzes for EHR with DSS compared with EHR without DSS provide also interesting results. EHR including DSS, that actively provides up-to-date medical knowledge, reminders or other actions that aid health professionals in decision making, showed in fact generally a better outcome. So, even if in this review we are far from knowing how EHR generates these quality improvements, this may suggest that such dynamic components are ones of the most effective parts of EHRs.” (Campanella et al., 2015)

Strengths and Weaknesses of the Selected Statistical Methods

The study had limitations; it focused on many indicators, and although doing a thorough search, we only discovered a small number of publications containing quantitative data among the articles listed, and even less for each indicator and subgroup. There was also a lot of variability, which might have influenced the results' robustness. Diverse types of software, their quality and usability, and different implementation settings are all possible sources of heterogeneity.

"EHR is also often considered an ideal tool to be used to assess healthcare quality and monitor health providers' performance because of the availability of stored computerized data. The last could allow automated quality assessment, avoiding manual chart review and medical record abstraction, both of which are expensive and time-consuming processes. This will require future research to focus on intervention strategies for improving both quality and comprehensiveness of clinical data stored in EHR and identifying the best process of data extraction." Campanella et al., 2015). To discover the characteristics that have value for both clinical results and quality monitoring, more study on technical items and methods that define EHR software is needed.

Reference

Campanella, P., Lovato, E., Marone, C., Fallacara, L., Mancuso, A., Ricciardi, W., & Specchia, M. L. (2015). The impact of Electronic Health Records on Healthcare Quality: A systematic review and meta-analysis. *The European Journal of Public Health*, *26*(1), 60–64. Retrieved February 27, 2022, from https://doi.org/10.1093/eurpub/ckv122