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Next Generation EHRs – What Problems Are These Systems Aiming to Solve?

Thomas SCHMIDT, Christian NØHR, Søren VINGTOFT, Paul TURNER

Abstract. EHRs elicit an array of different aspirations all underpinned by the widely held conviction that they can deliver benefits for patients, clinicians, researchers, IT vendors, policy-makers and society as a whole. While techno-centric visions abound, reflection on their history, the challenges evident in their design, implementation and evaluation and the limited evidence of their beneficial impacts over time is instructive. From a socio-technical perspective EHRs appear to be a set of ‘wicked problems’ unlikely to be resolved in favor of one position or another, but rather requiring judgement, nuance and negotiation around the kinds of problems we want these systems to solve. This paper presents some perspectives on important potential features for next generation EHRs and on the types of problems that these systems could aspire to solve. The focus is not on prediction but rather on actively shaping the kind of future that we desire and how EHRs will support its achievement.

Keywords. Electronic Health Records, Health Information Systems, Systems Integration

1. Introduction

Initiatives to develop new IT systems in healthcare are often characterized by techno-centric visions about how a particular technology, feature or function will deliver benefit. Difficulties related to a demanding implementation process and/or insights from evaluations of earlier failures tend to be marginalized, neglected and/or are left unexploited as important learning resources. In this context, the history of electronic health records systems (EHRs) is instructive. Important insights can be gained from a review of their specification and foci and the range of different aspirations that stakeholders have layered onto their delivery.

This paper critically reflects on how the EHR experience to-date may aid a reappraisal of priorities amongst these different aspirations and point towards the types of problems next generation EHRs should aspire to solve. These reflections occur in a context where most publicly funded health care systems globally have made huge investments in EHRs. Alongside promises of the transformative power of these systems it has been noticeable that reports of poor design, technology-induced errors and negative unintended consequences continue.

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Looking to the future, increasing amounts of health related data and information are being captured, analysed and exchanged under a vision of big data and automated data mining being the key to the delivery of health benefits from enhanced information timeliness and accuracy. For IT vendors such visions clearly support inflation in the feature and functional complexity of EHRs in ways intimately related to the underlying financial models of software sales. Questions about the utility, usability or effectiveness in terms of clinical or patient outcomes of such future systems continue to receive less attention than is perhaps advisable.

From a socio-technical perspective focused on drawing attention to the importance of users (patients, clinicians, researchers’ et al), usability and context, it is evident that system features, or rates of adoption and use are not the only relevant metrics. Safety and quality, clinical and health outcomes, enhanced understanding, communication and care emerge as key for clinicians and patients alike. From this perspective the ability of future systems to support the integration and visualization of multiple data streams in ways that empower users with data rather than accentuate their anxiety and suspicion, are worthy of greater consideration. This is especially the case for patients as EHR users, where differences in technical, textual and health literacy and social determinants must be mitigated rather than be further exacerbated by the next generation of EHRs.

1.1. Contemporary perspectives from dominant EHR vendors

In September 2017 Epic Systems CEO Judy Faulkner announced that the ‘E’ in EHRs should be replaced with a ‘C’ meaning comprehensive. The Comprehensive Health Record (CHR) was described as being different from the traditional EHR in three ways: 1) It contains information that is not currently in EHRs including data on social determinants, eating and sleeping habits, obesity, and whether individuals are isolated/lonely. 2) Information on care beyond the hospital i.e. primary and community care. 3) Information on care traditionally managed by the hospital that is now managed via tele-health apps and mobile web [1]. Epic’s rival EHR vendors Cerner, Athena Health and eClinical-Works immediately responded with announcements that their EHRs were to incorporate new data types, such as social determinants, population health and precision medicine to make EHRs more “comprehensive” [2]. Cerner CEO Zane Burke also promised to equip next-generation EHRs with interoperability in order for “data to flow freely” between Cerner’s own Millennium EHR and other vendors’ software. Similarly eClinical-Works’ new EHR, version 11 consists of cloud-based connectivity, interoperability, intelligence with genetic screening for precision medicine, predictive risk models for population health, and patient engagement features including telehealth services [2]. All vendors continue to promise that these new digital features and functions will further enhance the delivery of benefits from EHRs/CHR. But what problems are these features going to solve?

1.2. Patient/health records – an historical evolution

Patient records have a very long history. In Denmark patient records can be traced back to King Frederik the 5th (1723-1766) who founded the first hospital in Denmark in 1756 to treat and care free of charge for impoverished patients in Copenhagen. The King decreed that doctors should: *keep an orderly diary of the patients’ condition, the nature of the disease, any occurrences, and the medicines, which are prescribed to them,* and
write down these very same occurrences with exceptional accuracy ...the diary is to remain in the hospital when he leaves the service [3]. Ever since immense number of notes has been stored in paper forms, and the format of these paper records has been developed for more than 250 years. In the mid 1960’s the first computer systems were developed to store the growing number of text notes and numeric lab results. The first systems imitated the paper record structures and very few elements had specific generic data structures.

In 1991 the American Institute of Medicine (IoM) published a report “The Computer Based Patient Record (CPR). An Essential Technology for Health Care [4]. The IoM report identified five objectives for future patient record systems: 1) They must support patient care and improve its quality; 2) Enhance the productivity of health care professionals and reduce the administrative and labor cost associated with health care delivery and finance; 3) They must support clinical and health services research; 4) They must be able to accommodate future developments in health care technology, policy, management, and finance; 5) Patient confidentiality must be maintained while these objectives are being met. Subsequently, the report was revised and updated in 1997 [5]. New trends in health care delivery, management, and research were appraised to broaden the vision of CPRs in two areas: population-based management of health through computer-based population records and citizen-based management of health through another variant of the CPR, the computer-based personal health record. Since these seminal IoM reports EHRs have become a synonym for computer-based systems that perform a broad range of functions related to documenting and managing patient care.

In 2015 the American College of Physicians published a policy position paper on clinical documentation including 5 recommendations on EHR systems design including [6]: 1) The need to optimize systems to facilitate longitudinal care delivery and care involves teams of clinicians and patients over time; 2) To support clinicians' cognitive processes during documentation; 3) To support “write once, reuse many times” and embed tags to identify the original source of information; 4) To reduce requirements on users to check boxes or otherwise indicate observations/actions where this data is already proven by documentation in the patient record; 5) To facilitate the integration of patient-generated data whilst maintaining the identity of the source of the data.

Significantly, information from IT vendors web pages claim that most, if not all, these features and functions are available in their EHR products. However, there is a lack of available evidence validating these claims. On the contrary, extensive complaints from clinical users about these EHR systems continue, as does evidence of unintended consequences [7][8], medical errors attributable to design glitches [9], templates filled with meaningless data fields [10], and excessive warnings and alerts causing fatigue [11]. EHRs also appear to be suffering from an IT productivity paradox [12] such that numerous common work tasks like ordering a medication that took seconds using pen and paper (or dictation) can take much longer using EHRs [13].

2. A Socio-technical Approach: Reflecting on Users, Usability and Context of Use

Comparison of visionary predictions and contemporary evidence/experiences with EHRs is salutary – the future seems never to arrive! From a socio-technical perspective it is
unsurprising that there are different ways of conducting and interpreting clinical work. In hospitals this work can be characterised as interpretative, multi-tasking, collaborative, distributed, opportunistic, interrupted and usually reactive. Whereas the model embedded in EHR design is usually objective, rationalized, linear, normative, localized (in the developer’s mindset), solitary, and single-minded [14, 15]. To overcome this contradiction the design of the next generation of EHR systems should emphasize the problems and work tasks in context and in response to the needs of users if we are to produce a safe and sustainable next generation EHR fit for purpose.

Adopting more agile design, implementation, and evaluation approaches would stimulate a stronger collaborative model between vendors and users. It is anticipated that this would generate solutions better adapted to open-ended clinical and care problems. Such a partnership points towards a different approach to defining contractual arrangements. As an example, a recent EHR tender in the Region of Southern Denmark lists a number of strategic, tactical, and operational principles to formalize these types of collaborative arrangements [16]. Similarly, the collaboration between CSC and the NHS Trafford Clinical Commissioning Group to establish the Trafford Co-ordination Centre, offers another alternative approach to IT systems development [17].

3. Wicked Problems Require Negotiation, Nuance & Care

From a socio-technical perspective EHRs appear to be a set of ‘wicked problems’ unlikely to be resolved in favor of one position or another [18]. To optimize next generation EHRs will require recognition of the need for nuance, negotiation and care when focusing on the kinds of problems we want these systems to solve. To aid reflection on the issues and challenges Figure 1 presents a simplified staged model from development to operation covering the EHR lifecycle.

Figure 1 Challenges & issues for future EHR systems

**Development stage:** *Meaning alongside automation*; automated data analysis and learning should be counterbalanced by initiatives to integrate human participation (clinicians and patients) through meaningful interpretation. *Information plasticity* acknowledges that both input and output channels need to accommodate contextual customization for clinicians and patients alike. **Procurement stage:** *Stakeholder equality* catalyzing trust between vendors, buyers, operators, and end-users (clinicians and patients) to ensure true synergy. Establishing *local ownership* is of key importance in this regard, but requires a reconsideration of the technical power balance between vendor and buyer. **Implementation stage:** *Open data models* should be the starting point to ensure transparency, interoperability and adherence to long terms objectives of the health care system. In the same regard *standardized integration* using established regulated standards should be an immutable requirement regardless of the constraints it may exert on proprietary software modules. **Operational stage:** Accepting continuous change...
necessitates new ways of deploying dispersed learning throughout and beyond health care organizations into patients’ homes and communities. Broader integration will increase availability of data and information sources, and synchronization of data repositories must deal with trade-offs between speed, reliability, and capacity. Finally, as researchers we anticipate that this envisioned collaboration will extend beyond vendors and installation sites, to include evaluation to generate evidence and feedback on all stages to help extend learning beyond traditional non-disclosure boundaries.

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