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A Comprehensive Research Study Literature Review of EPIC© in Terms of Enabling Healthcare Agility: A Report Card

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Abstract

Background: As healthcare markets have become more dynamic and turbulent, healthcare organizations have evolved by becoming increasingly "Smart-Agile" in their business practices. Smart-Agility definition-ally ensures success due to its inherent ability to rapidly detect and react appropriately to varied and evolving unclear, complex, and seemingly tumultuous situations and produce high-quality, low-cost goods and services with high customer satisfaction. Thus, there is a vital need for Smart-Agile healthcare IT systems for collection, analyses, and reporting of substantial quantities of healthcare data to inform patient treatment and organizational decisions. EPIC® and its meaningful-use components appear increasingly popular, capturing a majority portion of the healthcare Electronic Healthcare Records (EHR) IT market (>~30%).Yet, there are few, if any, studies reporting on EPIC in terms of Smart-Agility.

Aim: The intent of this article is to report a systematic review of scientific literature regarding EPIC's healthcare IT systems meaningful-use features cross-compared with Smart-Agility aspects to produce a positive vs. negative report card—and whether its features are critical vs. non-critical in terms of Smart-Agility.

Method: Findings reported herein derive from a grounded, iterative review of open-source, peer-reviewed scientific literature following PRISMA.

Findings: Report card results were mixed. EPIC clearly succeeds and excels (better than average) on Smart-Agile healthcare IT system core aspects that are the most central, critical and valuable in terms of informing healthcare organizations' decisions and their patients' care (6 out of 7; B+, -A), specifically: Standardized Data Collection / Connectivity, Real-Time Data Warehousing/Outcome Measures, Enhanced Patient Safety, Patient Tracking and Follow-up (Continuity of Care), Patient Involvement, and Potential Use in Medical Education. The only critical core criterion it failed on was End-User Satisfaction, and some of that appears to dissipate with new users' software familiarity.

Conclusion: EPIC provides a solid and relatively inexpensive foundation with great potential for enabling Smart Agility in healthcare organizations with its high-quality collection and management of vast amounts of inter-connected raw data, auto-analysis, and fast report generation. But it does so with hidden costs and inefficiencies. Avenues of further inquiry are suggested.

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Background

As current healthcare business environments become increasingly dynamic and turbulent [1-3], many organizations have adapted successfully by adopting a concept of "agility" into their processes. [1, 2, 4 – 8]. Although the concept of agility originally derived from the manufacturing sector [3, 9], it has been increasingly transferred and incorporated throughout modern enterprises in general, especially the field of healthcare [10,11]. Simply defined, agility means rapidly responding to changing market conditions in order to acquire a position to take advantage and optimize opportunities [1, 4, 12 – 15]. Agility eponymously ensures the probability of successful operations by virtue of its ability to quickly detect and respond to any given situation. [16 – 20, 21] Agility also means continuous quality improvement by encouraging market-performance alignment within organizational strategic objectives. [1] The challenge arises out of extensive and varied operations in uncertain, complex, ambiguous, dynamic, and turbulent conditions [1]. Agile organizations are considered able to swiftly discern and conceive high-quality, low-cost, and high customer satisfaction-providing products, services, and solutions delivered within short suspense deadlines. [1] This highlights the need for information technology and systems for detection of intra-organization and external market characteristics and performance criteria in healthcare organizations. This requires large quantities of data and the infrastructure to collect and analyze it accurately and efficiently. [1, 5, 22 also see 23,24]

There have been specific Information Technology (IT) tools developed to enable organizations responsiveness to market changes, particularly in the healthcare industries, that have been studied in terms of their efficaciousness [16, cf. 25, also see 26]. Also, for healthcare organizations, there are certified off-the-shelf, on-the-spot, one-resource electronic records (EHR) software systems that have become popular choices. This is due to federal and state mandates and incentives for the adoption of "meaningful use" software that offer varying potential to inform and promote Smart-Agile patient medical treatment and organizational decisions.[27-35] For most healthcare organizations caught in the rub, the sensible choice has been EPIC ®[36], which has recently (circa 2019) and rapidly garnered well over 30% of the EHR market share and is seeking substantially more shares in other electronic records markets (e.g., academic, legal, human resources).[37, cf. 38] Therefore, it is only sensible to conduct a systematic review and evaluation of EPIC's meaningful use features in accordance with their relevance to smart enabling of healthcare organizations' agility, including: standardized data collection, technological somnambulism, time commitments and productivity, real-time data warehousing and (patient-centered) efficient production of outcome measures, enhanced patient safety, patient tracking and follow-up, end-user satisfaction, reminders, patient involvement, and potential use in medical education / training [see 38]. Yet, despite EPIC's preeminence in healthcare IT, there are few, if any, such appraisals on its contributions to Smart-Agility. Therefore, the intent of this article is to report a systematic and comprehensive review and assessment of EPIC's meaningful use features compared against what is termed aspects of Smart-Agile IT healthcare systems [10, 11, 39]—the ultimate aim of this work being the provision of a Smart-Agile report card for EPIC. Note, this is a review of EPIC only and only in terms of its meaningful use features cross-compared with Smart-Agility. EPIC is in no way considered representative of any other or all meaningful use EHR software, though in terms of other software being meaningful use EPIC may be reflective of those software(s). EPIC's examination here is justified in that it is currently the most popular and ubiquitous EHR software according to market share.

Method

The findings in this article derive from a 5-phased systematic, iterative "theoretic grounded" [40-41, cf. 42] literature review on EPIC in terms of the Smart-Agility that is depicted in Figure 1.

Figure 1 depicts the PRISMA evidence-based and best practices literature review research process that informed the work reported herein. Open-source peer-reviewed articles from multiple sources were identified and reviewed and conceptual themes generated. This process adhered to general best-practices guidelines and stipulations as per PRISMA [43-45] in order to provide a best-practices standard of a high-degree of independence and transparency to the methodological process. Also, following the PRISMA process in terms of a literature review depicted in a PRISMA diagram helps ensure: (1) a depiction of inclusion / exclusion criteria representativeness and comprehensiveness of the literature review; and, (2) exclusion of irrelevant literature (i.e., filler). [43-45]

Essentially, Figure 1 depicts the steps in this process. Step one involved deriving relevant keywords with which to search for articles and the results from a general canvassing of appropriate peer-reviewed medical/health and open-source subject matter databases, and applying search terms to the databases. Step two was reviewing abstracts or executive summaries for relevance, and retrieving relevant articles. Step three was identification and enumeration of themes and the retrieval of related information for review until all themes were exhausted. Step four was the actual review with a fifth step, which was cross-comparisons against Smart-Agile healthcare IT systems aspects also derived from the literature and reported throughout the Findings. Given that the process is "theoretically grounded" [40,41], though the steps are generally sequential and linear, they can be repeated individually or the researcher can cycle back and forth between steps. However, the eventual and ultimate aim was relatively comprehensive literature review that resulted in the identification, summation, and exhaustion of all themes. The one limitation in this method is that not all possible themes in the universe may have been identified. [40] However, this does not suggest that those identified herein are any more or less important or meaningful.

Themes are basic summary statements along with controverted issues (if any) that synthesize whether a meaningful use criteria meets Smart-Agility in terms of nominal presence and absence and backed-up with referenced citations. Note, there is no universal and absolute list of Smart-Agile aspects and these were culled from the Smart-Agility literature too (150). (Nevertheless, Dimirken's[10] seminal work is about the most comprehensive yet concise inventory.) Also, there was an avoidance of reporting deep delving into controverted issues in the interest of space limitations and avoiding confusion.

Findings

Standardized Information/Data Collection (Connectivity)

The hallmark of Smart-Agile healthcare IT systems and a critical aspect is their ability to "demonstrate unprecedented potential for fast delivery of automated intelligent and sustainable healthcare services," [10; p.39, cf.40] which EPIC clearly attains. Smart-Agile health care IT systems also promote coordinated services through auto-connectivity and comparable notes, especially patient notes—an additional Smart-Agility aspect for which EPIC scores high too. EPIC's potential for providing Smart-Agile healthcare lies in its ability to quickly connect information and retrieve standardized data for comparative analysis and because it requires pre-determined data outcome measurements. [28,29, 46 -65, cf.66] EPIC is able to generate accurate and timely reports based on requirements for entry of standardized data (e.g., EPIC "hard stops"*) [28,48,cf.66]. These can be immediately queried for programmatic evaluation and modification research. Yet, EPIC allows for modification/inclusion of evidence-based prompts and hard stops for identifying and mandating standardized data entry. [48]

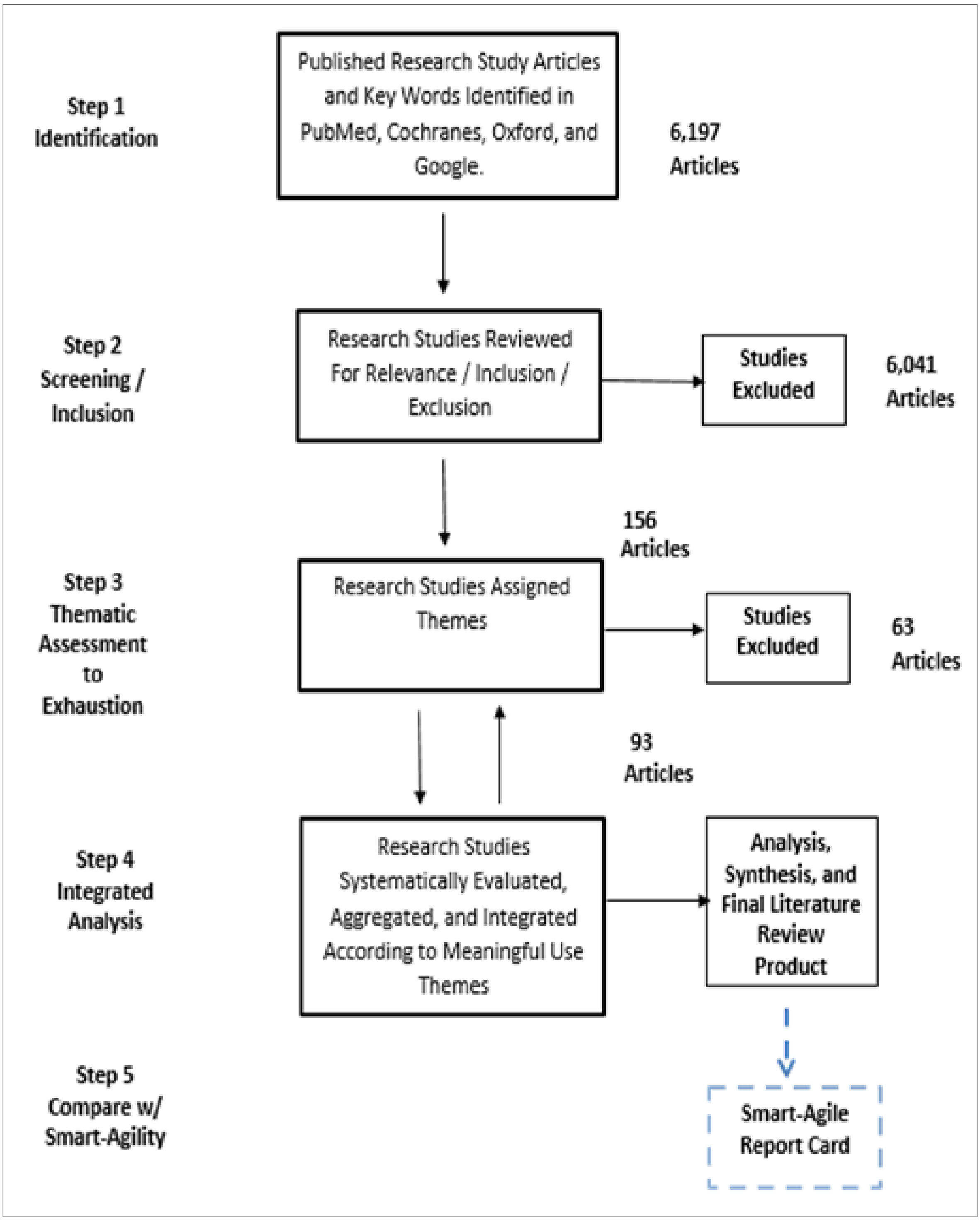

Figure 1. "Grounded" Literature Review

However, there has been concern about a disadvantage of a monopoly or market dominance that locks purchasers into a monoculture and maintains antiquated programming and retards responsiveness, de-confliction, flexibility, enhancement, and the ability to evolve—antithetical to the very essence of Smart Agility.[28,48,cf.10] Nevertheless, EPIC provides "…the additional software layers for easy access to (standardized) clinical information and serves as an accessible, evaluable platform for collecting and analyzing clinical outcomes…."[28] EPIC can be conformed to shepherd data entry and pre-identify errors and error patterns at the moment clinicians enter data. [28,51,52] Thus, data points can be identified and evaluated virtually in real time, almost immediately enhancing accuracy and quality of data as well as informing medical service adjustments. [28, 60, 61,63, 67-79, cf. 64]

A reported challenge was that EPIC is ill-suited for back-loading data and information in the standard format, which results in multiple and expensive remediation efforts. [47, cf.80] Back-loading continues to be a chronic and long-term problem, resulting in maintenance and the attendant expense of supporting several different systems that EPIC was supposed to eliminate in the first place.[80] Conversely, EPIC is easily able to capitalize on its standardized real-time workplace data entry of medical-condition-service-for-fee codes to identify patterns and practices.[80] It permits non-intrusive, accurate, and virtually real-time identification for analyses that could continuously operate unnoticed in the background.[28,29,49,51,53,82]

EPIC's standardized data-ready feature can be leveraged to track medical procedures and substantially reduce unplanned outcomes as well as facilitate clinically-based decision support.[46,47,81] EPIC's front-end-back-end standardized data entry, and query and data report generator, have been validated to eliminate the expensive, repetitive loading of data into multiple different systems.[82,cf.83]

EPIC also scores high in terms of the Smart-Agile aspects of provision for the development of targeted automatic algorithms to inform and support cost-effective medical and organizational decisions while taking into account possible risks.[28,30, cf. 10; p.44] Smart-agile systems consider responsive knowledge management key to high-quality, efficient healthcare, and they can alert and trigger marshalling of a substantial amount of comprehensive data to do so. [cf.10] Put differently, EPIC has shown the potential to support Smart-Agile healthcare through better information that increases quality with earlier, more appropriate, and less expensive treatments.[10,cf.84] Decision-makers can be enabled to make efficient and effective use of vastly increased amounts of data in modern information-driven healthcare industries. The capacity for more data in turn means more performance measures can be gauged. [1] This means a higher probability that healthcare organizations can quickly delivery the right products at the right time, with the right quality, and at the right price—the essence of Smart-Agile.[1, 85-87] Furthermore, adoption of Smart-Agile processes has been shown to direct service delivery toward a customer-oriented paradigm, which in turn supports agile decision-making in organizations, if not agility itself. [88]

Technological Somnambulism

Regarding technological constraints, EPIC fairs less well according to the Smart-Agile criterion of "quality."[25] Smart-Agile IT systems permit a degree of non-standardization in that customers/patients/ stakeholders and their needs are non-standard with differing "preferences, personal characteristics, and conditions."[10; p. 41] Then there are healthcare providers with differing backgrounds, professional roles, skills, training, and experience that must be accounted for.[10, also see 39] Therefore, to be Smart-Agile, healthcare IT systems must have both novel and standardize inputs, though EPIC tends to favor standardization.

Hard-stop-enabled standardized data entry comes with a downside, namely, risk of reflexive and non-reflective technology-driven hypnosis and even sleepwalking.[70-72, 90] EPIC suffers from issues surrounding all EHRs with meaningful use capabilities. Specifically, front-end data collection is shepherded, entailing overreliance on pre-determined (i.e., "canned") forms and templates for information collection—as opposed to producing truly meaningful data.[29] This may be further complicated by polished and slick-veneered electronic systems. This can be remedied by a dedicated team of medical experts, software designers and vendors updating and customizing forms and templates to capture relevant medical information throughout the medical care cycle—but those come at a steep price[29, 91, also see, 51] In this regard, a similar drawback with EPIC is that it does not permit entering more specific or different information[28], except through the incorporation of expensive add-ons that detract from its overall efficiency.[27, 82,92,93]

In terms of EHR product development, because the EHR development cycle is regulated, and thus lengthy, it also is expensive—anathema to Smart-Agile healthcare IT systems aspect [4, 10, 55, 74, 96; p.40, cf.58,64,78,79,83,93,94,95, also see 97]. Yet EPIC offers modifiable off-the-shelf packages that that keep costs relatively low and have the capability for continuous innovation and improvement in general. [27] Nevertheless, those innovations do involve costly teams of experts and designers, and so they score low in terms of Smart-Agility healthcare IT systems[10; p.41, 1] It is probably no better or worse in this area than other meaningful-use EHRs.

Time Commitments and Productivity

This is another area where EPIC does not fare well according to Smart-Agile IT healthcare systems aspects; specifically, additional expense and work burden on end-users.[10; p.41] Several issues are unescapable with all meaningful-use EHRs that turn clinicians into data entry clerks. One is the additional time commitment of entering data loaded onto the already time-intensive commitments of clinical practice. [50,56,82,83,89,90,97, also see 27,47,81] EPIC seems to be no different. Added documentation in EPIC also adds burden on healthcare providers.[83,98] However, the resulting seamless data analysis may be well worth the effort from providers' perspectives. Nevertheless, there is that substantial "after hours' time tax" to enter information.[56, 83,98,99,100,101,102]

Two, what really makes EPIC truly desirable for outcomes measurement, program evaluation, and research are its hard stops. [29, 65, 76, 96, 100, 101, 103, 104] However, they also pose a severe detraction or Achilles' heel in that they disrupt smooth workflow and also result in end-use dissatisfaction.[70,cf.68, also see 47] Nevertheless, it has been noted that medical providers' productivity work volume, charges, and work relative to volume units actually increases with EPIC; the caveat is that it takes several months of a painful learning curve to realize increased productivity. [81,also see 105, cf.63, 80,83,99,100101,102,106]

Real-time Data Warehousing and (Patient-centered) Efficient Production of Outcome Measures

Competitive agility, in accordance with Smart-Agility healthcare IT systems, is predicated on IT systems that are positioned "to produce, capture, store, process, and communicate."[10;p.41, also see 25]** Therefore, EPIC excels on this particularly critical Smart-Agility IT healthcare systems metric.

EPIC excels when it comes to drawing on the vast warehouse of data it stores and generating reasonably accurate (and extremely timely) outcome measures, which is eponymously the essence of "meaningful use." [71, 72, 90,also see27, 29, 46, 49, 54-56, 61,62,67,74,78,80,107,108,109] EPIC has been shown to substantially decrease multi-center decision support systems and time-to-decision, and physician's use of data to dramatically improve accurate diagnosis and treatment. [49,cf. 71-72] It has been shown that physicians using EPIC for data output substantially and geometrically improves accurate diagnosis; however, some of this was not possible without add-on programs that helped analyze the raw data that the back-end of EPIC produced.[81,89, cf. 27,47,71,90,102,108, also see, 49] There is substantial support for EPIC being the ideal front-end-to-back-end interface between required documentation and clinical research.[3, 51, 61, 71, 82, cf.47, also see, 79,107,108,110].

Another feature of IT systems that enable agility is that they provide secure, high-quality data exchange essential to efficient health care[10; p.41], which the literature clearly suggest EPIC provides. In this regard, EPIC's capability in accordance with this Smart-Agile healthcare IT systems is remarkable; EPIC "overcomes the healthcare barriers involved with data-driven and analytical decision including but not limited to: incomplete personal healthcare data, unconnected or silo'ed data, large amounts of unstructured data, and even paper-based records."[10; p.41] The literature suggests EPIC has a track record—per Smart-Agile IT systems criterion— of 'high-quality, secure, compliance-driven, intra-operability enabled by healthcare experience and geared toward efficient change and process management.'[10;p.41] EPIC enhances big-data enabling of business intelligence (BI) as well as knowledge-management for the collection, analysis, and dissemination of substantial amounts of structured and unstructured data for quick actionable and accurate decisions.[106] And "big data" promises yet-untapped potential of insights into miracle cures, disease etiology, waste prevention, and every imaginable realm of healthcare to include informing Smart-Agile decisions.[22]*

Enhanced Patient Safety

Critical to Smart-Agile healthcare IT systems is the "provision of informed seamless patient-centric for actionable healthcare delivery paramount of which is the maintenance of patient safety."[10; p.43, also see 25, cf.88] EPIC's ability to quickly and accurately derive outcome measures is critical in terms of efficient and timely identification of potentially deadly patient hazards and targeting those patients for intervention.[49, 59,61,74,75,81,97,100, 106-108, 111-116, cf.57] EPIC is a powerful tool to monitor adherence to prescribing best practices, but only with rather expensive add-ons with which to conduct analyses and a lot of hard stops interfering with workflows.[also see 29,81,89,117, also see,75,77,79]

EPIC facilitates the coordination of patient healthcare to promote safety and long-term wellness, while remaining cost-effective through comparable patient notes.[10;p. 39-40] And Smart-Agile healthcare IT systems lend themselves to the aspect of "development of tools to better real-time monitor processes and outcomes to include safety, and in particular for the healthcare industry, patient safety."[cf.10] EPIC's ability to standardize and connect resources "accelerates patient recoveries, enhances evidence-based practices and less-expensive preventive medicine—and thus, provide Smart-Agile improved care."[10, also see,22]

Patient Tracking and Follow-up

A critical cornerstone of Smart-Agile healthcare IT systems concept is systems integration, i.e., inter-operability and inter-connectivity that permits ease of follow-up in the interest of continuity of care and also safety. [10; p.41, also see 25] EPIC's ability to accurately derive and report information in almost real time to identify patient safety risks also lends itself to excellent patient tracking, monitoring, and follow-up.[28, 29, 46, 61, 73, 94, 95, 107, 117] EPIC is an excellent system for electronically tracking patients and their procedures, and documenting complications, risks, and sources of unplanned outcomes.[46] EPIC also provides an excellent data recording system for conducting inexpensive, continuous four-year longitudinal patient surveys; it also permits easy aggregation by type and level of complications, though this requires expensive add-on algorithms.[117, cf.69] In this regard, EPIC also scores high on another Smart-Agile healthcare IT system criterion, service provision, including personalized medicine and the connectivity features to support that [10; p.41, also see 25].

End-user Satisfaction

According to Smart-Agile IT healthcare systems, end-users' satisfaction is critical because it relates to a large degree to stakeholder buy-in (as end-users are one group of stakeholders).[10; p.41] Specifically, users' satisfaction with their healthcare IT system is important because "healthcare organizations represent powerful stakeholders whose concern is high-quality healthcare provision and delivery, not learning or wrestling with IT."[10; p.41]

End-user satisfaction is one area where EPIC scores are mediocre or even low or failing; the range of physician average satisfaction rates are between 50 – 75% depending on the particular EPIC feature.[3,27,102,104,106,109,118,cf.47] One key feature that resulted in the most end-user dissatisfaction was EPIC's "Reminder(s)"; they operate much like its hard stops in that they must be addressed before proceeding with workflow.[29,47,70,89,cf.106] This clearly detracts from EPIC's usefulness in terms of preventive medicine and patient safety. Overburdening and overwhelming medical treatment providers with best practices advisories in large numbers generate scores of complaints.[47,cf.106] Marked improvement on end-user satisfaction was noted when limits were placed on Reminders.[70,89] Nevertheless, Reminders significantly improve compliance among providers in terms of orders and rates of adherence to directive and documentation.[70-72] This may be why EPIC works better than other EHRs that use passive collection in terms of outcomes. But extreme dissatisfaction has been noted with it and results in less-than-optimal use of some key EPIC functions. One reason the end-users feel this way is that data entry for them is inefficient and too time-consuming.[cf.3, 29, 47, 55, 63, 70, 76, 77, 79, 89, 106, 110] Smart-Agile healthcare IT systems must be efficient to warrant their cost, and EPIC probably needs improvement regarding this end-user feature. Put differently, it needs to clearly demonstrate value-added in terms of time-consuming data entry.[10; p.44]

Patient Involvement

A critical aspect insinuated throughout Smart-Agile healthcare IT systems is patient involvement in their healthcare via IT systems—an area where EPIC has shown a track record and vast potential.[10; p.39] Specifically, Smart-Agile healthcare IT systems must involve patients as primary end-users (a.k.a., stakeholders).[10; p.39] The promotion of patient-centric wellness involves the unified amalgamation of different IT delivery systems.

EPIC's connectivity and ability to electronically transmit real-time medical chart information securely over the Internet has vast potential regarding proactive integration of patients into the management of their own healthcare[27,34,47], even older non-tech-savvy patients.[93] This can enable and empower patients to easily and smoothly transfer or upload images and documents from outside sources and physicians to shift their patient management to more virtual vs. less face-to-face encounters.[47]

According to Smart-Agile healthcare IT systems aspects, EPIC's aim to consolidate processes and simplify, demystify, and automate business practices—while involving patients in their healthcare—creates and synchs a collaboration between patients as valued partners with providers.[10;p. 41] As such, EPIC has the potential to involve both patients and providers as co-producers in Smart-Agile medical treatment, and this will alter the fundamental pattern of those interactions.

Of course, all this requires a common (i.e., standardized) language that EPIC facilitates. And according to Smart-Agile healthcare IT systems rationale, process orientation has been shown overall to support cost reductions, improve product quality and customer satisfaction, and decrease the production cycle time.[10; P.41, cf. 88]

Training

The literature on Smart-Agile healthcare IT systems appears to understate ongoing training that must necessarily accompany dynamic IT systems. Thus it is considered non-critical[25] Nevertheless, there has been identification in the EPIC literature of the essential need for ongoing training in terms of transitioning and exploiting EPIC's potential to its fullest[47,59,61, 63,77,104,105,109,121, 80] Smart-Agile healthcare IT systems literature tends to view training as an additional expense and encumbrance to be avoided, as opposed to an investment in the future in terms of responsiveness and efficiency.[119,120, cf.79] Perhaps this is an area that the Smart-Agile IT systems researchers and proponents should reconsider as vital and revisit.

Potential Use in Medical Education

The Smart-Agile healthcare IT systems proponents recognize that Smart-Agile systems represent a platform from which to deliver healthcare training to healthcare professionals; this is considered a critical aspect.[10; p.41,44, also see 25, 26, 39] EPIC also has potential as a tool for the delivery of medical training and education. [27, 29, 60, 83, 90, 95, 98, 105, 106, 121] However, EPIC's standardized templates impose limits on documenting and dictation and thus detract from its potential for medical education in terms of extemporaneity.[90, also see 27,29,98]. Hence, EPIC appears to adhere to the Smart-Agile healthcare IT systems criterion of encouraging the involvement of healthcare providers—the "powerful" stakeholders in healthcare organizations—in the IT systems as generators of high-quality data and recipients of up-to-date healthcare training with the aim of ultimately improving patient care through informed analytic decision of best practices. [10; p.44, also see 39]

Report Card on EPIC in Terms of Smart-Agile Healthcare IT Systems

The findings in the literature review in this article on EPIC' meaningful use features graded in terms of Smart-Agile healthcare IT systems aspects are summarized in the "Report Card" that is depicted in Table 1. Scoring of themes was simple nominal presence or absence in terms of synthesized summary statements of meaningful use featuress with referenced citations in the literature. Nominal presence / absence avoids subjectivity that would be encountered with Ordinal – Ratio numeric scoring. Criticality was determined according to the necessity / criticalness in terms of Smart-Agile aspects. Note: EPIC's meaningful use features potential to meet or not meet Smart-Agility aspects were also counted as presence and absence respectively—not a subjective matter of degree.

Table 1 depicts that, when EPIC is graded in terms of Smart-Agile healthcare IT aspects, EPIC's meaningful-use components appear mediocre at best (7 out of 11), and fail at worst (6 out of 11). However, EPIC succeeds and excels on Smart-Agile healthcare IT systems aspects that are the most central, critical and valuable (7 out of 8) in terms of informing healthcare organizations' decisions and their patients' care, specifically: Standardized Data Collection / Connectivity, Real-Time Data Warehousing/Outcome Measures, Enhanced Patient Safety, Patient Tracking and Follow-up (Continuity of Care), Patient Involvement, and Potential Use in Medical Education. Also, this work highlighted an area that Smart-Agile healthcare systems should consider, namely, IT education.

Conclusion

This work reported a comprehensive best-practices literature review derived from peer-reviewed articles on "meaningful use" features of EPIC's EHR system related to their potential to fulfill the Smart-Agile healthcare IT systems concept—that is, their ability to inform and enable agile healthcare organization decisions and patient care. As such, this work derived a presence-absence report card on EPIC's ability to afford smart use and enhance Smart-Agility—the report card was mixed.

This comparative review revealed that EPIC provides a rigorous front-end-to-back-end system for the rapid collection and inter-connected management of medical records information that lends itself to efficient

Table 1. EPIC Report Card

Rating	EPIC Meaningful Use Features	Critical / Non-Critical
+	Standardized Data Collection	C
-	Technological Somnambulism	NC
+	Real-time Data Warehousing and (Patient-centered) Efficient Production of Outcome Measures	C
-	Time Commitment and Productivity	NC
+	Enhanced Patient Safety	C
+	Patient Tracking / Follow-up and Continuity of Care	C
-	End-user Satisfaction	C
+	Patient Involvement	C
(+)	(IT) Training	NC
+	Potential Use for Medical Education	C

reporting and informing agile management decisions. Thus, it truly has the ability to accurately inform Smart-Agile organizational advancement, in particular for patient medical treatment and healthcare organizations in general.

Nevertheless, that accuracy and rigor is achieved at a (hidden) cost, specifically, increased workloads on medical practitioners and various cross-team over-commitments that result in inefficiency, which in turn detracts from agility and is not smart use. The question in terms of agility is: At what point does the price exceed the benefit of agility sought, so that it is no longer a smart use investment?

Researcher experience clearly suggests that EPIC can provide substantial raw data that can be further refined with add-on analytic tools, auto-algorithms, or hands-on user analyses. EPIC's exacting and comprehensive (auto) interconnected data collection lends itself to nearly real-time provision of information to powerfully improve the accurate responsiveness and agility of healthcare organizations and medical treatment decisions.[28]

Thus, EPIC has the unparalleled ability to augment agility in terms of enhancing patient safety and tweak treatment adjustments accordingly—through not only comprehensive inter-connected data but also limited and worthwhile reminders and hard-stops. Conversely, increased and unwarranted data entry and hard stop reminders are not smart use; they detract from agility in that this can cause extreme dissatisfaction in end-users as well as frustration, aggravation, and burn-out in busy medical practitioners.

Furthermore, used indiscriminately, EPICs standardization is not Smart-Agile nor contributes to agile practice and decisions. This is the flipside and danger of meaningful use systems, namely, Technological Somnambulism. Specifically, the computer is doing the leading and driving. Cognizant organizational decision makers and practitioners switch to auto-pilot and are just blindly along for the ride. Without analytically sharp decision-makers at all levels using the high-quality information EPIC culls to inform Smart-Agile practices, the computer becomes an end in itself rather than a means or tool to an agile end. EPIC does favor consistency and relationships where, if unguided by discerning and reflective medical insight, EPIC's medical information could easily become vacuous and powerless, especially in terms of Smart Agility.

Nevertheless, EPIC's most profound and yet-to-be-tapped benefit to users is as an IT teaching tool. Note, this is an feature overlooked in terms of smart and agile use, and should be included in any future discourses. EPIC has also shown great promise in terms of synergizing patient connectivity and involvement in their own healthcare—which is an aspect of smart use and agility.

The report card on EPIC is mixed. Yet it should be noted that Smart-Agility is an ideal. And all IT systems are imperfect at best. Nevertheless, as EPIC increasingly governs large swathes of EHR market shares and makes inroads into other IT markets that involve records, the challenge will be whether users can overcome its inflexibility and accommodate more aspects of Smart-Agile use.[cf.48] EPIC, like all meaningful use IT healthcare systems, has federally mandated features. Thus, another important question is how well EPIC's competitors do in terms of smart use and agility and whether the ideal of the Smart-Agility concept is even a fair test for software never originally designed with this in mind. These considerations were not the province of this study but will be matters for future investigations.

***Note:** A hard stop is a prompt that will not allow an operation to proceed without entering particular data in a standard and correct format.

****Note:** This is variously referred to in the Smart-Agile literature as "portfolio management," that is, Smart-Agile decisions based on valid and sufficient information derived from interoperability, stability, compressive-ness, and rigor, and continuously aimed at project operations in competitive and turbulent situations to seize opportunities and advance healthcare organization goals.[87]

Declarations

Ethical Approval and Consent to Participate

Non-applicable, this was a review of open-source documents and analyses of anonymous publically available data.

Consent for Publication

Yes.

Availability of Data and Materials

The "datasets" used and/or analyzed during the current study are available from the corresponding author on reasonable formal request.

Competing Interests

None Declared.

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Authors' Contribution

Non-applicable, there is one sole Author.

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