Clinical Decision Support Systems: Resolving the "Build or Buy" Dilemma

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Care that is important is often not delivered. Care that is delivered is often not important[1].

The importance of clinical care grounded in a reliable evidence base cannot be over-emphasised. Evidence-based care processes, supported by automated clinical information and decision support systems, offer the greatest promise of achieving the best outcomes[2]. Proprietary Clinical Decision Support Systems (CDSS) built on evidence-adaptive platforms incorporating clinical knowledge that continually reflects current EBM gleaned from both the research literature and sources of practice expertise will soon outgrow self-synthesised (home-grown) solutions. This paper explores this process.

> Clinical practice is full of contradictions, not only where individual professional experiences conflict, but even where "evidence" partially or completely disagrees. The primary reason for these inconsistencies is that evidence is dynamic and emergent, never constant.

THE FALLIBILITY OF EVIDENCE

Evidence can often be incomplete, with varying levels of quality and strength of recommendations[3]. Keeping up with latest evidence and eliminating its inconsistencies is quite an arduous task and carries the inherent risk of practicing outdated medicine (with occasional catastrophic consequences).

Consider the following scenario:

> A 2 month-old infant comes to your office suffering from heart failure. She has a prescription for two drugs that reduce excess fluids from the body (diuretics), prescribed by a cardiologist based on evidence demonstrating the effectiveness of the two medications when administered together. One of the drugs reduces the body's level of potassium (an important electrolyte) while the other conserves potassium. You are doubtful that two drugs are required for the treatment of such a young patient. Given the amount of time it will take to find evidence to address your skepticism, you call the cardiologist. Unfortunately, the prescribing cardiologist is unavailable, so you then call another renowned cardiologist. He tells you to stop the second drug based on professional experience that it causes growth problems in infants as well as his belief that potassium loss is of little concern in infants. You are now left wondering what is best for your tiny patient, having moved from a stage of having no information to a stage of conflicting "information noise."

Given such realities of evidence-based medicine, one must consider: is the business of extrapolating evidence something providers and healthcare organisations are willing to do on their own?

THE EVIDENCE DELUGE

It has been estimated that greater than two million articles are published in the biomedical literature each year[4]. If a physician were to attempt to keep up with this literary explosion by reading two articles each day, at the end of one year, that physician would be more than sixty centuries behind! If physicians were to read everything of possible clinical relevance, they would need to read around 6,000 articles a day!

Compounding this problem is the conundrum of diffusion. "Diffusion" is the spread of best (research) evidence on managing diseases and symptoms to the patient bedside[5]. According to conventional wisdom, it takes an average of 17 years for validated clinical research findings to make their way into routine clinical practice[6]. In an age where global public health emergencies (like the recent Zika virus outbreak) require "knowledge hyper-loops" for rapid diffusion of knowledge into general practice, the 17-year latency needs to be radically shortened to 17 hours or even less.

A SOLUTION TO ACCELERATE LEARNING HEALTH SYSTEMS

Clinical Decision Support Systems (CDSS) have been described as the Computerised Patient Record (CPR) System's Crown Jewel[7]. According to Gartner's CPR generations (Fig 1), CPRs or Electronic Health Records (EHRs) have had an increasingly positive impact over the last few decades in reducing medical errors. With the inclusion of CDSS, the EHR evolves from being a provider "colleague" to a "mentor," with the power to cover the entire care continuum in guiding clinicians at all points of care.
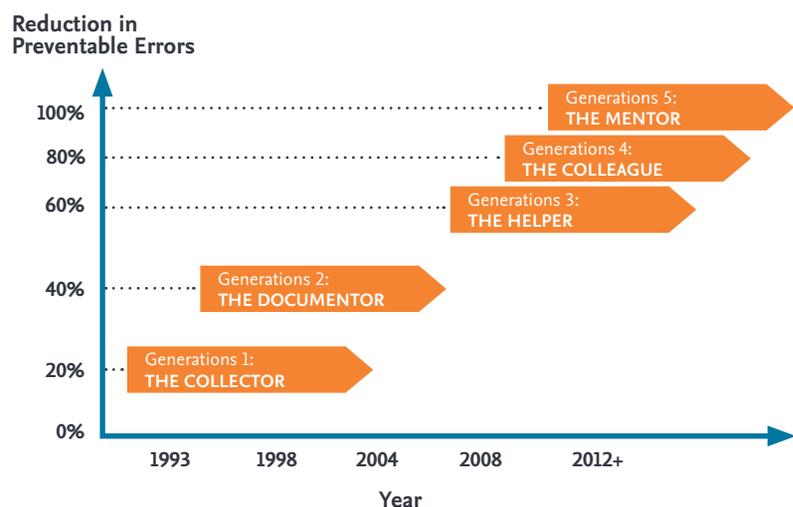

Fig 1: Gartner's EHR Generations[8]

We are now seeing the evolution of the Sixth Generation EHR - "The Seer," that has computable, standardised clinical data able to invoke clinical decision support from evidence-adaptive CDSS platforms. Although at present evidence-adaptive platforms require human intervention, we are now beginning to see the inclusion of artificial neural networks (deep learning), Bayesian networks, reinforcement learning, and other artificial intelligence techniques for synthesising evidence relevant to patient data in real-time, with potentially unprecedented insights for clinicians. Intelligence Augmentation (IA), where technology amplifies the decision-making capabilities of humans, has linked healthcare providers to vast amounts of patient data with relevant clinical knowledge, in real-time, at the point-of-care. We are likely to soon witness wide-scale proliferation of IA in Sixth Generation EHRs that incorporate evidence-adaptive CDSS.

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This kind of evidence-adaptive CDSS is at the heart of a Learning Health System (LHS)[1], wherein evidence influences practice and the practice, in turn, generates evidence, creating self-propagating, virtuous cycles that bring about better, safer clinical care at optimal costs.

There are six critical success factors (Table 1) for a CDSS, based on the ACUDIR model (Latin for "Come to the Rescue"), that can form the foundation of such a rapid LHS.

Table 1: ACUDIR Model

Critical Success Factors for CDSS	
Active	Proactively recommends action
Cognitive	Aware of the patient context
Unobstrusive	Seamlessly integrates with Standardised clinical workflows
Decisive	Improves clinical decision making
Intuitive	Simple & predictable user interfaces
Responsive	Evidence-adaptive

CDSS solutions like Order Sets, Care Plans, and Clinical Pathways are a combination of evidence-based content and advanced technology platforms. The dilemma which healthcare organisations face today is whether they can "build" such advanced CDSS on their own or if they should "buy" proprietary CDSS products.

IMPLICATIONS OF BUILDING CDSS

While the idea of building a CDSS that perfectly fits your organisation's unique workflows appears an obvious choice, it eventually becomes clear that maintaining such a one-of-a-kind system can be unsustainable.

Medical knowledge-base construction and maintenance is a significant challenge. After the first few years of creating the knowledge base, adding new evidence to the system is no longer research – it is system development. As such, it becomes increasingly difficult to recruit a cadre of medically knowledgeable individuals who can devote substantial effort to knowledge-base maintenance over time. Creating a Clinical Practice Guideline (CPG) usually takes three to six months (or even a year), depending on the subject matter[9]. The maintenance of a CPG is likely to take more than a quarter of the time it took to originally develop the Guideline[10]. To develop CPGs, a standard set of guidelines covering all specialties, represents 12,000 hours of work at a cost of more than 1 million USD for just the content alone[10]. The total cost of authoring, reviewing, and EHR integration can surpass 3 million USD for just 200 Order Sets[11].

With the growth of Fifth and Sixth Generation EHRs, the concept of building in-house CDSS will increasingly become less favorable.

BENEFITS OF BUYING CDSS

As we move from logical (rules-based) CDSS to a foreseeable future of statistical (machine learning-based) systems, the decision to purchase rather than build and maintain knowledge-based CDSS becomes a sensible, convenient and cost-effective choice (Table 2).

Table 2: The Build Buy Decision Matrix for CDSS

	Logical CDSS	Statistical CDSS
BUILD	Fallible	Infeasible
BUY	Sensible	Foreseeable

First and foremost, choosing to "buy" third-party CDS Solutions can help to outsource the huge burden of managing and updating the clinical knowledge base to a vendor that provides the dual advantage of access to peer-reviewed content created by experts, and amalgamating organisational workflows with evidence-based practices via collaborative platforms.

Building consensus amongst "experts" becomes easier when the source of evidence is credible.

Advanced CDSS are usually built on accepted and defined standards that have been peer-reviewed and fine-tuned to provide higher sensitivity and specificity for each condition.

Customisation can also be taken a step further by selecting solutions that have a content management system for ease of customising the content to fit specific guidelines of the organisation. These external CDSS may also have a proven track record of effectiveness with other organisations, which in turn results in costs savings for less 'trial-and-error' as compared to "building" CDSS. The return on investment is primarily in the form of reduced spending on unnecessary tests and procedures as well as avoidance of costly adverse events (and in many systems, malpractice litigation claims), and secondly in the form of saved care replacement costs that result from pulling clinicians away from care processes (to build CDSS). These savings can add up to significant amount annually – almost 2.6 million USD as per one estimation[11].

Furthermore, such standard CDSS implementations enable interoperability in Health Information Exchanges. As far as project implementation is concerned, an external influence provides the opportunity to reengineer improvements into your original processes. Advancements in interoperability standards also facilitate more seamless integration with EHR. Professional practice services for EHR integration and implementation support that are provided by progressive knowledge partners, can cut down the implementation costs significantly and improve the efficiency and effectiveness of a large-scale CDSS roll-out.

Lastly, with pharmacogenomics becoming an emerging field in patient care, demand for this new form of CDSS is increasing. In this case, building this knowledge base seems even less of an option when considering the expertise and time needed to manage and update it.

CONSIDERATIONS IN SELECTING CDSS

As with all third-party platforms, the convenience that comes with buying often includes challenges that need consideration. These include the integration effort for disparate platforms, investment in system upgrades and the additional effort from IT staff for monitoring the performance of these external platforms. Legacy stand-alone CDSS systems need to be integrated or discontinued.

Yet, certain safeguards or mitigation plans can be considered to maximize the advantage of buying CDSS. These are best summarized in the following five C's:

1. **Clinical team**: Selection and implementation of the CDSS should involve the clinical teams to ensure that it meets the needs of the end-user for successful adoption and continued usage

2. **Credibility**: Consider vendors with a proven case of working with other providers to smoothly manage the change experience

3. **Capability**: Evaluate vendor's ability to effectively synthesize evidence into evidence-adaptive technology platforms, thereby successfully bringing about true practice transformation

4. **Configuration**: Ensure EHR platforms have been configured to integrate with CDSS and updated to comply with latest interoperability standards

5. **Computation**: Define metrics that measure performance of each CDS element and outline a clear process for monitoring to tweak elements that are underperforming

Following the appointment of a vendor, healthcare organizations should further establish governance structures and develop a clinical knowledge management framework that can consistently track and improve effectiveness of their chosen CDSS platform. In all, keeping in mind the above considerations will enable providers to better chart out their journey towards a successful CDSS adoption.

CONCLUSION

With the deluge of evidence that is often fallible and slow to diffuse into clinical practice, along with advanced EHR platform integration requirements, hospitals must reconsider their likely initial inclination towards building their own CDSS. A number of major initial and ongoing challenges with home-grown solutions, including care replacement costs, time and effort to constantly update evidence; usability; implementation and maintenance costs; and accepted functional practice integration can be overcome with the purchase of proprietary CDSS. Overall, the selection of CDSS should also involve the clinical team from the start, as well as careful selection of vendors who show a high level of willingness to partner in the transformation journey.

REFERENCES

1. McGinnis JM, Aisner D, Olsen L. The Learning Healthcare System: Workshop Summary. National Academies Press; 2007.

2. Corrigan J, others. Crossing the quality chasm. Build a better Deliv Syst. 2005.

3. Guyatt GH, Oxman AD, Vist GE, et al. GRADE: an emerging consensus on rating quality of evidence and strength of recommendations. 2008.

4. Lundberg 2nd GD. Perspective from the editor of JAMA, The Journal of the American Medical Association. Bull Med Libr Assoc. 1992;80(2):110.

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5. Greenhalgh T, Robert G, Macfarlane F, Bate P, Kyriakidou O. Diffusion of innovations in service organisations: systematic review and recommendations. Milbank Q. 2004;82(4):581-629.

6. Balas EA, Boren SA. Managing clinical knowledge for health care improvement. Yearb Med informatics 2000 Patient-centered Syst. 2000.

7. B. Hieb. How to Use IT to Reduce Medical Errors in the Acute Care Environment.; 2003. http://www.bus.umich.edu/KresgePublic/Journals/Gartner/research/118600/118639/118639.html

8. Handler T, Hieb B. The Updated Gartner CPR Generation Criteria. Gart Teleconference. 2007;13.

9. Working Group on CPG Update. Update of clinical practice guidelines in the National Health System: methodological manual. 2009.

10. Elsevier CPM Resource Center. Borrow, Build or Buy?; 2012.

11. Elsevier. Order Sets ROI Calculator. 2017.

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