F R O S T & S U L L I V A N

50 Years of Growth, Innovation and Leadership

The Introduction and Impact of ClinicalKey, Elsevier's Clinical Insight Engine

CONTENTS

EXECUTIVE SUMMARY

As a global growth consulting, advisory and research firm, Frost & Sullivan monitors trends in a broad range of healthcare markets to understand the factors that drive the adoption of new IT-led solutions and systems.

In 2013, healthcare providers across the globe will continue to wrestle with reconciling rising demand, falling budgets, increasing costs and heightened expectations, while individual physicians and medical students must keep on top of advances in technologies, improvements in treatments, and the development and launch of new drugs.

It is against this background that Frost & Sullivan has examined the role of technology in clinical decision support and, in particular, reviewed Elsevier's ClinicalKey solution.

The platform, through its breadth of coverage, the authority of its content and its speed to answer, offers the potential to support healthcare providers and physicians alike with better negotiating these myriad challenges.

The principal findings of this review are as follows:

- Technology-based solutions in general and Clinical Decision Support Systems in particular offer a way in which to reconcile the challenge of meeting the rising demand for healthcare, while simultaneously managing and reducing rising costs.

- There are currently a range of solutions, from e-books to search engines, that are available in the market but each only offers a partial solution, compromising either on the depth, breadth and reliability of information that is available, or the speed and ease with which it can be retrieved.

- Elsevier has launched a combined database and search engine—ClinicalKey, a "clinical insight engine"—which aims to bridge this gap and leverage new semantic search technologies and the company's experience in developing clinical content to align itself directly with clinicians' workflows.

- Frost & Sullivan's research shows that ClinicalKey has the content (both Elsevier-developed and third-party sourced) and functionalities to fulfill this aim and that the solution has been very well received by its early adopters since its launch in April 2012. Users value, in particular, its versatility, ease of use and the comprehensive coverage of specialties.

- As ClinicalKey continues to gain traction, there is an opportunity for the platform to make a tangible contribution to improving the quality of healthcare through the provision of reliable, timely and current medical information at the point of care (POC).

THE CHALLENGE OF MEETING DEMAND FOR AND REDUCING THE COSTS OF HEALTHCARE

"In many parts of the globe, hospitals—in developed countries in particular—are suffering from the twin pressures of increasing demand for care and the spiralling costs of its provision."

"It is something of a paradox that, despite the financial pressures, patients and regulators continue to expect improvements in the speed with which illnesses are diagnosed and the quality of the treatment that is administered."

"The development of a decision support tool that provides quick and reliable answers would have the potential to save time and therefore money while improving patient outcomes."

Technology-based clinical information solutions offer a way in which to reconcile these seemingly mutually exclusive goals

In its recent survey of the financial health of the United Kingdom's National Health Service (NHS), the Audit Commission found that the number of Trusts that are struggling to balance their books has risen from 13 in 2011 to 31 in 2012.[i] This is symptomatic of the situation in many parts of the globe with hospitals, in developed countries in particular, suffering from the twin pressures of increasing demand for care and spiralling costs of its provision.

The position in the United States (U.S.) is similar. Here, President Obama's much-debated 2010 Patient Protection and Affordable Care Act (PPACA or "Obamacare" as it is commonly known) was passed with the aims of increasing the number of insured Americans and reducing the overall cost of healthcare. In 2010, the latest year for which figures are available, the U.S. spent more on health than any other country, with 17.6 percent of its Gross Domestic Product (GDP) significantly above the Organization for Economic Co-operation and Development's (OECD) average of 9.5 percent.[ii]

It is something of a paradox then that—despite these financial pressures—patients and regulators continue to expect improvements in the speed with which illnesses are diagnosed and the quality of the treatment that is administered. In Japan, for example, a HawkPartners/ICARE survey revealed that 39 percent of respondents[iii] were dissatisfied with the healthcare system. This compares with similar numbers of 28 percent in Germany and 27 percent in the U.S.

Against this backdrop, Frost & Sullivan's research and coverage across the healthcare sector shows that administrators, hospitals, physicians and, indeed, patients are increasingly looking to innovative technology-based solutions and systems that allow them to address the seemingly mutually exclusive challenges of reducing mid-to long-term costs while simultaneously improving the quality of patient care. Selected examples of IT-led systems that are fulfilling this purpose include Electronic Health Records (EHR) and "mobile healthcare" (mHealth) solutions:

- EHR – From an adoption rate of just 12 percent in 2009 to forecasted penetration of 90 percent in 2016, uptake of EHR in the U.S. is set to be driven by regulatory changes and payment reforms together with the demonstrable benefits to patients.[iv]

- mHealth – By emerging into a major market in just five years, mHealth represents a key element of the future of healthcare, with solutions such as fitness apps and text services generating revenues of $400 million in the U.S. in 2012.[v]

The area of Clinical Decision Support (CDS)—which Frost & Sullivan defines as the provision of "software applications which integrate patient data with a knowledge base and an inference mechanism to produce patient-specific output in the form of, for example, care recommendations [… in order to] actively support practitioners in clinical decision-making"[vi] —is another domain in which technology has and continues to play a dramatic role. Integrating

evidence-based clinical reference content into these decision-support tools empowers the physician to leverage trusted literature with patient-specific queries at the point of care.

According to a *British Medical Journal* (BMJ) study, a team of researchers observed 103 physicians across the course of one working day. Collectively, the group posed 1,101 clinical questions of which two-thirds remained completely unanswered, while it required the equivalent of more than 13 hours to find appropriate responses to the 400 questions that were deemed sufficiently critical to research; of these, only two triggered a trip to the library.[vii]

It is clear, therefore, that the development of a Decision Support System (DSS), which clinicians are able to use at the point of care and that provides quick and reliable answers, would have the potential to save time and money, while also improving patient outcomes.

CURRENT CLINICAL SUPPORT SYSTEMS AND THEIR ADVANTAGES AND DISADVANTAGES

From e-books to search engines to aggregators, the current offering of online resources that are available offer only a partial solution to requirements

The idea of a Clinical Decision Support System (CDSS) is not new.

Historically, of course, physicians and medical students have always had access to impressively stocked shelves of books, journals and reviews. The very strength of hospital or campus libraries— the breadth and depth of the coverage that they provide—is, however, also the source of their greatest weakness since, as illustrated by the BMJ's study, the time required to locate the most relevant and authoritative resources renders their everyday use impracticable.

The ability to digitalize content and host this online has radically changed the way in which resources are made available to healthcare professionals.

In particular, the development of "interactive" CDSS in the 1990s began to crucially address what an Elsevier survey has identified as clinicians' principal "pain point"—that medical information, up until that point, was "only available in printed form." [viii]

Today, physicians and medical students have access to a range of both generalist and specialist search engines and aggregators that have made further advances.

Frost & Sullivan research shows that the online solutions that are currently available in the market all look to meet clinicians' demand for "ease of use" and have also improved the speed and accuracy with which relevant content is returned to a greater or lesser extent.

Unfortunately, the flip side to the accelerated access is generally a compromise on either the comprehensiveness or the trustworthiness of the information available, with content focusing on a limited variety of specialties or a narrow range of clinical activities.

"The ability to digitalize content and host this online has radically changed the way in which resources are made available to clinicians."

"Unfortunately, the flip side […] is generally a compromise on either the comprehensiveness or the trustworthiness of the information available."

Figure 1 below illustrates the relative advantages and disadvantages of a range of CDSS resources against the following key metrics:

- Breadth and depth of coverage

- Authority of content

- Time required for each inquiry

- Ease of use/intuitiveness

Figure 1. Comparison of the advantages and disadvantages of clinical reference tools

● STRONG ○ WEAK	COVERAGE	AUTHORITY	TIME	EASE
Library-print books, journals, clinical reviews	◗	◗	◖	◖
Online e-books, journals, clinical reviews	◐	◐	◗	◐
Generalist search engines	◗	◔	◗	◗
Aggregators or specialist search engines	◐	◗	◕	◕

Source: Frost & Sullivan analysis

ELSEVIER'S CLINICALKEY: A "CLINICAL INSIGHT ENGINE"

Elsevier launches a combined database and search engine that leverages its experience and content, and pivots this to align directly with clinicians' workflows

Positioning, Aims and Objectives

In April 2012, Elsevier launched ClinicalKey, a combined database and search engine—a "Clinical Insight Engine." ClinicalKey aims to address the shortfalls of CDSS tools and, through the provision of trusted evidence-based referential content, revolutionize the way in which medical information is made available to and applied by clinicians.

The launch represents the culmination of months and, indeed, years of planning and preparation. Elsevier has a very strong presence in the health sciences space through its ScienceDirect and MD Consult solutions. With ClinicalKey, however, the company has sought to build on this

experience, combined with the direct input and feedback of more than 2,000 clinicians, to develop a single platform that is tailored directly to physicians' needs and requirements.

In particular, the aim of ClinicalKey is to provide a solution that enables clinicians to access "health knowledge" near the POC and integrate it into their workflows.

Elsevier ran a survey that shows that medical practitioners spend the majority of their time (more than 45 percent) managing a patient's care, condition and treatment.[ix] ClinicalKey is designed to accompany physicians across this process and support a very wide variety of clinical activities—from, for example, diagnosis to preventive care, therapeutics, disease management and prognosis—regardless of the setting and the clinical specialty.

Frost & Sullivan's Assessment

Frost & Sullivan has had access to ClinicalKey over a period of three months and has had an opportunity to assess the way in which the solution performs against the key metrics set out above and in comparison to the historical and current resources that are available.

A summary of our principal findings are set out in Figure 2 below:

Figure 2. Assessment of ClinicalKey against clinicians' principal pain points

- Breadth and depth of coverage

ClinicalKey offers direct access to Elsevier's vast collection of resources. The company boasts an impressive range of—and provides "full-text" access to—more than 500 journals, 1,000 books and 13,000 videos across all medical and surgical specialties. In addition, Elsevier has complemented its renowned in-house library (including its Medical and Surgical Clinics of North America, Procedures Consult and Clinical Pharmacology content) with access to a selection of reputable third-party materials and data, such as MEDLINE abstracts.

- Authority of content

Elsevier's journals, books and video content are peer-reviewed and draw from evidence-based content. ClinicalKey brings together all of the company's existing respected and trusted content into a single platform. In addition to Elsevier's content, it has acquired access to trusted third-party content as well as including clinicaltrials.gov, the Gold Standard drug database, Exitcare patient education materials, and full indexing of Medline.

- Time required for each inquiry

Despite the breadth and depth of coverage that it offers, ClinicalKey is distinguished by the speed with which the search engine is able to locate and return the most clinically relevant responses. This rapidity is facilitated by its Smart Content functionality, with the system using "taxonomy tags" to allow ClinicalKey to have a "semantic understanding" of the content that it is searching. This enables the platform to go beyond the capabilities of a standard "keyword search" to deliver the most clinically relevant results to users.

- Ease of use/intuitiveness

ClinicalKey's rapidity is complemented by its simplicity. The solution's main interface is not unlike that of an online search engine and is intuitive to use. This, combined with the comprehensive "tips and tools" section, saves more time by negating the need for any training.

A further feature that sets ClinicalKey apart is its ability, enabled by Elsevier's proprietary Smart Content "Merged Medical Taxonomy" technology (EMMeT)—which refines and combines existing taxonomies such as SNOMED CT, RxNorm, ICD-9 and LOINC—to highlight links between medical concepts and related content that other clinical decision support tools may miss.

In practice, this means that when a physician or medical student types a key term into ClinicalKey, the search engine returns a range of related options. Inputting the work "hyperthyroidism," for example, returns results such as "serum T3 measurement," which is a diagnostic test for the disease, and "iopanoic acid," a drug that can be used to treat it. As such, ClinicalKey is—as one reviewer put it—"already thinking like a physician" by pointing directly to additional data and information on specific aspects of patient care.[x]

- Additional features

The platform is also distinguished by a range of additional features.

In particular, Frost & Sullivan recognizes ClinicalKey's "Presentation Maker" option and one-click e-mail functionality as key to facilitating collaboration between physicians, and of particular use to medical students and teachers in preparing and/or delivering classes.

The platform will also be "personalizable." Current functionality allows users to save searches and, therefore, save additional time.

Together, these three complementary features allow ClinicalKey to support medical practitioners beyond their core focus on patient management and to add value to a second significant work flow: "professional development." Research suggests that physicians spend almost 25 percent of their time "sharing information" for internal and external presentations and committees, and "keeping current."[xi] These are tasks that—although less frequent than the day-to-day work of planning and executing care plans—require access to reliable medical information.

Sources: Elsevier/ClinicalKey, Frost & Sullivan analysis

THE EXPERIENCES OF "EARLY ADOPTERS" OF CLINICALKEY

Since its launch in April 2012, ClinicalKey has already begun to bring tangible benefits to clients with clinicians united in praising its comprehensiveness

Based on this assessment, it is clear that ClinicalKey has the necessary content and functionalities to make a tangible impact for both clinicians and medical students. Frost & Sullivan has, however, tested its analysis by speaking with a range of "early adopters" in the Americas, Europe and Asia Pacific in order to understand the ways in which ClinicalKey is being deployed and the advantages in concrete terms that it is already starting to bring.

The feedback was broadly very positive.

Frost & Sullivan's research showed that the capabilities and characteristics that interviewees chose to highlight as most beneficial varied according to each respondent's role within the organization. To a certain extent, this in itself is testament to the fact that Elsevier has—in line with its objectives—been able to develop a solution that is in step with healthcare practitioners' principal work streams and provides support across different clinical specialties and settings.

In particular, as illustrated in greater detail in the following selected case studies, it is notable that those in librarian or information functions value the breadth and depth of coverage; physicians tend to praise the speed and accuracy of the Smart Content search functionalities; while those in a teaching or research role find that the variety of content formats and ability to easily share content lead directly to time and efficiency gains.

It is also worth noting that, across institutions, there is a common sense that the decision to acquire ClinicalKey in the first instance was driven by a desire to consolidate each organization's often disparate clinical decision support-making resources. As one interviewee at Johns Hopkins University succinctly put it, "ClinicalKey integrates content into a single box"—a statement which again underlines the comprehensiveness of the medial information that it provides.

"ClinicalKey augments [the resources] that we have … [it is] easier to use, integrating all of the content … into a single box."

Case Study 1. Johns Hopkins University, United States[xii]

John Hopkins University, United States

World renowned center for patient care, research and education

Using ClinicalKey …

Frost & Sullivan spoke with an associate director at the University's Welch Medical Library, which recently acquired ClinicalKey as part of a broader process of streamlining the number of systems that students and physicians use. Indeed, the breadth of coverage that is included and, in particular, the number of e-books available was a factor in the decision to deploy ClinicalKey.

At Johns Hopkins, the librarians are called informationists and are "embedded," accompanying physicians on their rounds. This close proximity to patients has allowed the interviewee to observe the way in which ClinicalKey is more "practice- rather than theory-orientated." In particular, she noted the way in which its "Smart Content" search functionalities allow physicians to quickly locate and scan the most relevant content for a specific clinical question.

Associate Director, Welch Medical Library, Johns Hopkins University

Sources: Johns Hopkins University, Frost & Sullivan analysis

Case Study 2. Gunma Children's Medical Center, Japan[xiii]

> *Gunma Children's Medical Center, Japan*
>
> *150-bed diversified pediatric hospital*
>
> *Using ClinicalKey …*
>
> Frost & Sullivan spoke with a physician at Gunma CMC who, as a specialist in pediatric hematology and oncology, was one of the main driving forces behind the hospital's decision to acquire ClinicalKey. It was in this, as well as the Allergy and Infectious Immunity department, that the platform was trialed in the second half of 2012. Now, ClinicalKey is used by 40 physicians and was selected on the basis that it provided a single solution to the physicians' needs.
>
> In addition to providing an everyday tangible benefit, the interviewee reported that the decision to deploy ClinicalKey was also based on the assessment that the platform would provide a good return on investment. This was both in terms of its ability to open up access to a broad range of resources in a cost-efficient manner, but also to support in attracting and retaining residents through the provision of best-in-class resources and facilities.
>
> *Physician, Gunma Children's Medical Center*

Sources: Gunma Children's Medical Center, Frost & Sullivan analysis

"[We] didn't compare ClinicalKey with other products because [it] has the full text of all the magazines and journals that we want to read."

"The search engine is easy to use … fast, intuitive … it provides broader content [than platforms that I have used in the past]…"

Case Study 3. Universidade Estadual Paulista, Brazil[xiv]

Universidade Estadual Paulista (UNESP), Brazil

One of Brazil's largest and most prestigious state universities

Using ClinicalKey …

Frost & Sullivan spoke with an experienced professor pediatrician at UNESP, who has been using ClinicalKey for the past six months. She described the way in which she uses the platform in her work. Since the focus of her role is on teaching, she finds the variety of content types (e.g., images, videos, presentations) very valuable in both preparing and delivering her classes. She also highlighted the way in which she is able to access full books and easily share material with colleagues and students as a key point of differentiation versus other solutions.

On the basis of about five hours use each week, the interviewee believed that ClinicalKey has increased her overall productivity and allows her to "gain several hours" per month.

Professor Pediatrician, UNESP

Sources: UNESP, Frost & Sullivan analysis

LOOKING FORWARD TO CONTINUED IMPROVEMENTS IN THE QUALITY OF HEALTHCARE

Greater and improved access to reliable, timely and current medical information at the POC has a key role to play in driving up standards and improving patient outcomes

It is clear, from just these examples, that ClinicalKey is already bringing advantages to the many hundreds of individual healthcare practitioners who currently have access to the solution and the institutions in which they work. Indeed, Frost & Sullivan detected a very clear sense of optimism amongst those with whom it spoke that—with familiarity and greater adoption—the benefits that ClinicalKey provides will continue to increase over time.

In a broader sense, of course, greater and improved access to relevant clinical information at the POC will have its most significant impact, beyond the potential efficiency savings, in terms of the provision of better quality healthcare.

Frost & Sullivan's research shows that the implementation of clinical decision support tools has proven to be effective at improving patient outcomes by, for example, reducing adverse drug events and medication errors, while the ability to consult reliable, timely and current medical information allows clinicians to avoid unnecessary tests and speed up diagnosis and treatment for the patients who come under their care.

KEY CONCLUSIONS

There are strong theoretical reasons for believing that greater access to relevant clinical information for healthcare professionals at the point of care can translate into improvements in healthcare quality, patient safety and organizational efficiency—and there is an increasing body of evidence to suggest that this promise translates into practice.

Numerous evaluations of CDSS have taken place, but perhaps the most comprehensive assessment to date is the "Systematic Review" by Garg, et al. This often-quoted study demonstrated that, across 100 controlled randomized and non-randomized trials, the presence of a CDSS was shown to have a beneficial impact on practitioner performance in more than 70 percent of cases.[xv]

Despite this persuasive evidence, Frost & Sullivan's research shows that, while CDSS have been successfully deployed in many settings, their full potential is yet to be realized at a national or regional level in both the U.S. and elsewhere. Relatively low levels of widespread adoption can be explained by a range of macro factors, including:

- The continuing lack of awareness amongst healthcare bodies and governments as to the benefits that CDSS can bring

- The difficulties of connecting CDSS with the disparate range of IT systems currently deployed both within and between specialties, departments and organizations

Frost & Sullivan's work in the CDS space demonstrates, however, that the most significant restraints to greater deployment have been the lack of a "common base of clinical knowledge" and the "variability of accessibility" of solutions—in other words, "the difficulty in finding the most useful clinical knowledge and decision support interventions to meet a specific need."[xvi]

Elsevier's launch of ClinicalKey, by combining a vast volume of authoritative content with superior speed and ease of access, addresses this challenge and has the potential to serve as a turning point in the development of the CDS market and, more importantly, make a decisive contribution to improving the quality of patient care.

ABBREVIATIONS

BMJ	British Medical Journal
CDS	Clinical Decision Support
CDSS	Clinical Decision Support System
CMC	Children's Medical Center
DSS	Decision Support System
EHR	Electronic Health Records
EMMeT	Elsevier Merged Medical Taxonomy
GDP	Gross Domestic Product
mHealth	mobile healthcare
NHS	National Health Service
OECD	Organization for Economic Co-operation and Development
POC	Point of Care
PPACA	Patient Protection and Affordable Care Act
UNESP	Universidade Estadual Paulista
U.S.	United States

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ABOUT ELSEVIER

Elsevier is a world-leading provider of scientific, technical and medical information products and services. The company works in partnership with the global science and health communities to publish more than 2,000 journals, including The Lancet and Cell, and close to 20,000 book titles, including major reference works from Mosby and Saunders. Elsevier's online solutions include ScienceDirect, Scopus, Reaxys, ClinicalKey and Mosby's Nursing Suite, which enhance the productivity of science and health professionals, and the SciVal suite and MEDai's Pinpoint Review, which help research and health care institutions deliver better outcomes more cost-effectively.

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