CLINICAL DECISION SUPPORT SYSTEMS:
THE TIME HAS COME...

A Frost & Sullivan Market Insight
The work of healthcare professionals and physicians is largely a work of making decisions and solving problems. It is a work of choosing issues that require attention, setting goals, finding or designing suitable courses of action and evaluating and choosing among alternative actions. They must choose from and interpret a huge variety of clinical data, while facing pressure to decrease uncertainty, risks to patients and costs. The true essence of healthcare delivery is decision making - what information to gather, which tests to order, how to interpret and integrate this information into diagnostic hypotheses and what treatments to administer.

Despite great steps forward, however, uncertainty still plays a pivotal role in most aspects of medical decision making. Doctors may know that a patient does not have long to live, but they cannot be certain how long. Similarly, they may prescribe a potent new receptor blocker to reverse the course of a patient’s illness, but they cannot be certain that the therapy will do so without side effects. This uncertainty is compounded by the information overload that characterises modern medicine. Today's experienced clinician needs close to 2 million pieces of information to practice medicine and doctors subscribe to an average of seven journals, representing over 2,500 new articles each year, making it almost impossible to keep abreast with the latest information about diagnosis, prognosis, therapy and related health issues. Furthermore, the interpretation of patient data is difficult and complicated, mainly because the required expert knowledge in each of many different medical fields is enormous and the information available for the individual patient is multidisciplinary, imprecise and very often incomplete.

This has prompted the need to provide means for clinicians to receive the relevant research-supported evidence necessary for safe, effective and efficient clinical decision making. Computers offer the obvious solution both for the management of information and for its faster retrieval.

In this insight we will look into the need to monitor, measure, and reward quality of care in the United States; how Clinical Decision Support Systems can play a significant role in the process; and how some of the reform initiatives planned for the US health system can be compared with modernisation efforts by European countries.

The Need to Monitor Quality

During the last decade hundreds of authoritative studies have clearly revealed the very considerable variations in the extent to which the performance of healthcare professionals and healthcare systems vary. Americans, for example, receive recommended evidence-based care, on average, only 55 percent of the time — with care for some conditions falling well below 50 percent. It is widely believed that the situation in many, if not all European countries is characterised by similar deficiencies.
Problems with quality have traditionally been classified into three areas, namely:

- shortage of technical and interpersonal competence;
- overuse or unnecessary or inappropriate use of services; and
- underuse or lack of access to needed and appropriate services.

Improving quality of care is complex and includes implementation of evidence-based practices (where possible catalysed by the development of clinical practice guidelines for example), continuing medical education and professional development, regulation, assessment and accountability, and of course patient empowerment mainly by publishing performance data and creating public pressure.

In any case, the key to evaluating and ultimately improving quality is monitoring performance and although there are numerous quality monitoring efforts there is yet no consensus on the best way to measure and improve quality. In the US, the past decade has seen dedicated measurement tools being developed to assess the performance of hospitals, nursing homes, and physicians with the most common ones shown in Figure 1.

**Figure 1: Sets of Quality Measures Used in the US Healthcare System**

- **HEDIS**
  The most widely used set of quality measures is the Healthcare Effectiveness Data Information Set (HEDIS), developed through an alliance between health care plans and employers. Since its creation in 1991, HEDIS has evolved to include a broader range of measures that examine underuse, overuse, and misuse of services. Today HEDIS is primarily used to measure the quality of care delivered by HMOs – it is used by more than 90 percent of America’s health plans and altogether, consists of 71 measures across 8 domains of care. HEDIS is maintained by the National Committee for Quality Assurance (NCQA).

- **CAHPS**
  The Consumer Assessment of Healthcare Providers and Systems is a standardized survey of patients’ experiences with care. Health care organizations, public and private purchasers, consumers, and researchers use CAHPS results to assess the patient-centeredness of care, compare and report on performance, and improve quality of care. CAHPS was developed by the Agency for Healthcare Research and Quality (AHRQ) in partnership with numerous private organizations.

- **Hospital Compare**
  Medicare’s voluntary hospital quality system reports how often hospitals provide recommended care for a heart attack, heart failure or pneumonia, and to prevent infections acquired during surgery. Measures were developed by the Hospital Quality Alliance (HQA) and adopted by Medicare in 2003. Hospitals that report the measures receive a full annual update in Medicare payments; those that do not lose 2 percentage points on the update.

- **Nursing Home Compare**
  Nursing Home Compare collects information on nursing home residents’ health, physical functioning, mental status and general well-being using a tool known as the Minimum Data Set (MDS).

- **Home Health Compare**
  Home Health Compare uses the Outcome and Assessment Information Set (OASIS), which is a group of data elements that represent core items of a comprehensive assessment for an adult home care patient.

- **MEDPAR**
  The Medicare Provider Analysis and Review (MEDPAR) File contains data from claims for services provided to beneficiaries admitted to Medicare certified inpatient hospitals and skilled nursing facilities (SNF).

*Source: adapted from Covering Health Issues, 5th Edition, Alliance for Health Reform*
Use of Quality Measurements

Public release of performance information can be a powerful driver for quality improvement and forces providers to try and show progress over time. In the US, many employers use quality measurement results to guide their choices of their sponsored plans and providers. For example, two-thirds of Fortune 500 employers currently require health plans to be accredited by NCQA and/or to report HEDIS data. State insurance regulators and administrators of Medicare and Medicaid also require or at least encourage hospitals and HMOs among others to report quality information.

Rewarding Outcomes

In recent years, public and private sector leaders have been experimenting with ways to spur quality improvement through incentives. Also known as "pay for performance" these efforts offer incentives ranging from financial bonuses to positive publicity for health care providers who excel.

Bridges to Excellence (BTE), a non-profit, employer-driven initiative, focuses on areas with a deep history of measurement: diabetes care, cardiovascular care, and patient self-management systems. Participating physicians receive bonus payments and are highlighted in provider directories, helping employees and their families make informed choices with encouraging results so far.

In California, the Integrated Healthcare Association (IHA) works with health plans, medical groups and independent practice associations to reward quality in three domains: clinical, patient satisfaction, and adoption and use of information technology (e.g., EHRs, CPOE). A similar organisation, the Leapfrog Group, rewards hospital performance via public recognition and bonus payments to hospitals that report data in several areas of patient care.

Public programs like Medicare and Medicaid are also embracing the pay for performance approach. For example, on January 15, 2009, the Centre for Medicare and Medicaid Services announced that it would stop Medicare payment for medical procedures performed incorrectly, on the wrong patient or the wrong part of the body. In addition, effective with discharges since October 2008, Medicare no longer pays hospitals a higher rate for an inpatient stay if the reason for the higher payment is one of a number of hospital-acquired conditions.

Figure 2 lists some of the key organisations involved with monitoring and rewarding quality in the United States.
The Situation in Europe

The United Kingdom is seen as one of the leaders in using financial incentives as drivers of quality improvement. Quality issues are addressed in a range of ways outlined below.

Regulatory bodies: a number of bodies monitor and assess the quality of health services provided by public and private providers. This involves regular assessment of all providers, investigation of individual providers where an issue has been drawn to the attention of a regulatory body and consideration of key areas of provision in order to recommend best practice. The National Institute of Clinical excellence is the key agency responsible for providing guidelines on improving quality of care in the UK and is supported by different agencies such as HQIP, Care Quality Commission, The Health Foundation and NCCHTA (Figure 3). Through the constant support of these agencies the quality of care is monitored and outcomes are rewarded for hospitals across the United Kingdom.
Targets: targets have been set by the government for a range of variables that reflect the quality of care delivered. Some of these targets are monitored by the regulatory bodies mentioned above; others are monitored on a regular basis either by the Department of Health or its regional organisations (the strategic health authorities).

National Service Frameworks (NSFs): since 1998 the Department of Health has developed a set of NSFs intended to improve particular areas of care (for example, coronary disease, cancer, mental health, diabetes). These set national standards and identify key interventions for defined services or care groups. They are one of a range of measures used to raise quality and decrease variations in service.

Quality and Outcome Framework: this is a framework for measuring the quality of care delivered by GPs. It was introduced as part of the new GP contract in 2004, which provided incentives for improving quality, and has been operating since 2005. GP practices are awarded points related to payments for how well the practice is organised, how patients view their experience at the surgery, whether extra services are offered, such as child health and maternity, and how well common chronic diseases such as asthma and diabetes are managed.
In Germany, a range of measures have been introduced to ensure quality of care, such as the requirement for all providers to establish a quality management system; the obligation for continuous medical education for all physicians; health technology assessment for drugs and procedures, for which the Institute for Quality and Efficiency (IQWiG) was founded in 2004; voluntary hospital accreditation; and minimum volume requirements for a number of complex inpatient procedures (such as transplants). Care quality is addressed through the mandatory quality reporting system for all acute hospitals. Under this system, over one hundred and fifty indicators are measured for thirty medical conditions covering about a sixth of all inpatients. Hospitals receive individual feedback. Since 2007, around thirty indicators are required to be made public in the annual quality reports that all hospitals must publish.

An accreditation system is used to monitor the quality of care in hospitals and clinics in France. Hospitals must be accredited every four years by a team of experts. The accreditation criteria and reports are publicly available via the national health authority (Haute Autorité de Santé, HAS) website (www.has-sante.fr). Every fifth year physicians are required by law to undergo an external assessment of their practice in the form of an audit.

Similar initiatives and measures have been introduced by several other European countries.

**Clinical Decision Support Systems**

Clinical decision support systems (CDSS), are gaining increased recognition in healthcare. CDSS can be broadly defined as *software applications that integrate patient data with a knowledge-base and an inference mechanism to produce patient specific output in the form of care recommendations, assessments, alerts and reminders to actively support practitioners in clinical decision-making.*

Computerised decision support systems can be stand-alone or integrated within or interfaced with other clinical information systems. Engagement with a CDSS can be active or passive meaning that end-users can actively choose to engage with a CDSS or this support can be automatically provided whilst entering information into the electronic health record, ordering tests, prescribing, or undertaking other clinical information system related activities. Patient data can be input by digital entry, queried from other clinical information systems or transmitted from medical devices. Patient data are compared against a knowledge-base and made sense of by an inference mechanism. The knowledgebase can be procured commercially or developed in-house. The inference mechanism can be highly variable in sophistication ranging from simple ‘yes’ ‘no’ and ‘if’ ‘then’ statements to Bayesian prediction techniques and/or fuzzy logic. The output can also take a number of forms and can be delivered to a number of destinations at any time before, during or post-interaction with the patient. Computerised clinical support systems can vary greatly in design and function, undergoing a continuing evolution of their scope and application.
Scope of CDSS

The general premise underlying the use of CDSS is that they support clinicians in making more informed decisions and as such, have the potential to impact on the quality—the effectiveness, efficiency and economics—and perhaps most importantly, the safety of healthcare. CDSSs can be used for a variety of clinical activities such as preventive care, diagnostics, therapeutics, comprehensive disease management, image recognition and interpretation and prognostics. Theoretically, CDSSs can be used for any speciality of clinical care and in any setting where the requisite knowledge-base and technological infrastructure exists.

Additionally, CDSSs can support research studies by identifying patients who may fit a certain description and assisting in management of such individuals in accordance with research protocols. CDSSs can also provide assistance with quality assurance activities such as tracking orders and referrals with no results, need for follow-up and need for preventive services, supporting clinical coding and documentation, procedures authorisation and referrals management. The plasticity of this application suggests a diverse range of opportunities for impact on the quality and safety of healthcare.

How CDSS can Help Quality

There are strong theoretical reasons for believing that improved access to relevant clinical information for healthcare professionals, at the point of care, can translate into improvements in healthcare quality, patient safety and organisational efficiency. Numerous practical evaluations of CDSSs have taken place in a variety of ways (systematic or otherwise) looking at particular conditions (e.g. computer-aided diagnosis of melanoma), different settings (e.g. neonatal care) or aspects of clinical care (e.g. reminders for preventative care). The most comprehensive assessment to date is the Systematic Review by Garg et al. that assessed 100 controlled trials—randomised and non-randomised—comparing the effect of care with a CDSS to care provided without a CDSS on practitioner performance and patient outcomes. CDSS have shown to be beneficial in more than 70% of cases.

In addition, clinical decision support systems have proven to be effective at improving outcomes at several state-of-the-art health care institutions by reducing adverse drug events, medication-related errors and costs by millions of dollars per year even within single hospitals. If these results could be scaled up to a regional/national level, CDSS have the potential to save thousands of lives and billions of dollars each year.
Current CDSS Market

CDSS has been deployed effectively in a few settings, but their full potential for optimising the United States healthcare system is far from realised. According to the latest HIMSS Analytics Data on EMR adoption (Figure 4), only a small percentage of caregivers use clinical information systems that provide more than very limited CDS capabilities.

Figure 4: HIMSS Analytics EMR Adoption Rates in the US Healthcare System

<table>
<thead>
<tr>
<th>Stage</th>
<th>Cumulative Capabilities</th>
<th>Q2 2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage 7</td>
<td>Medical record fully electronic; HCO able to contribute CCD as byproduct of EMR; Data warehousing in use</td>
<td>0.3%</td>
</tr>
<tr>
<td>Stage 6</td>
<td>Physician documentation (structured templates), full CDSS (variance &amp; compliance), full R-PACS</td>
<td>1.0%</td>
</tr>
<tr>
<td>Stage 5</td>
<td>Closed loop medication administration</td>
<td>4.5%</td>
</tr>
<tr>
<td>Stage 4</td>
<td>CPOE, CDSS (clinical protocols)</td>
<td>3.6%</td>
</tr>
<tr>
<td>Stage 3</td>
<td>Clinical documentation (flow sheets), CDSS (error checking), PACS available outside Radiology</td>
<td>38.4%</td>
</tr>
<tr>
<td>Stage 2</td>
<td>Clinical Data Repository, Controlled Medical Vocabulary, Clinical Doc, may have Document Imaging</td>
<td>31.6%</td>
</tr>
<tr>
<td>Stage 1</td>
<td>Ancillaries – Lab, Rad, Pharmacy – All Installed</td>
<td>7.2%</td>
</tr>
<tr>
<td>Stage 0</td>
<td>All Three Ancillaries Not Installed</td>
<td>13.4%</td>
</tr>
<tr>
<td>Total Hospitals</td>
<td></td>
<td>n = 5167</td>
</tr>
</tbody>
</table>

Even where CDS is deployed, the implementations often do not effectively use and present the best available clinical knowledge, thereby limiting impact and the degree of clinical improvement. More specifically:

- drug-drug interaction checking modules and drug-allergy checking modules are the primary CDS interventions that are routinely being purchased and implemented.
- Most organisations that use CDS do not have dose checking capabilities.
- Some current CDS systems generate too many “false positive” alerts, or interrupt clinical workflows in a manner that can disrupt efficient care delivery. As a result, some clinicians and institutions sometimes “turn off” the CDS capabilities within the commercial systems that they purchase.
The nascent state of CDS is due in part to the complexity that arises from the nature of decision making, the intellectual challenge of creating knowledge, technical dimensions of delivering CDS, and social aspects of incorporating changes into clinical care. This creates a pressing need for high-quality, effective means of designing, developing, presenting, implementing, evaluating, and maintaining all types of clinical decision support capabilities.

**US releases $1.2 billion for EMRs**

The US government is releasing $1.2 billion to help healthcare providers implement and use electronic medical records. The grants include $598m to set up about 70 health information technology centres, which will provide technical assistance and support for the implementation of EMRs. A further $564m will be spent on health information networks to allow information to be shared nationwide. President Barack Obama’s administration has pledged to give every American an electronic record within five years, arguing that this is “fundamental to reforming” the entire healthcare system.

The government has set aside in total more than $20 billion in economic stimulus funds to improve patient care and cut costs. The first round of grants is being funded from the American Recovery and Reinvestment Act of 2009 and will be made available in 2010 in a series of waves. Future payments to healthcare providers will depend on them showing “meaningful use” of electronic records — a term that is yet to be clearly defined — but which will definitely have an impact on the Clinical Decision Support Systems market. Under the stimulus legislation, providers will only have until 2015 to purchase equipment and software that meet federal requirements, in order to be reimbursed by the government — a strong driver for immediate growth in CDSS applications.

However, since fewer than 20% of US doctors are thought to use EMRs at the moment, there are concerns that providers will find it difficult to meet the president’s deadlines while a lot of other issues have yet to be resolved - from interoperability to privacy and funding priorities.

**England’s National Programme for IT**

The efforts by the Obama administration inevitably direct some attention across the Atlantic, looking at progress with England’s *National Programme for IT*. The National Programme for IT (NPfIT) is a plan for investment and reform aimed at improving the use of IT in the NHS over a period of 8 to 10 years with a total cost of over $12 billion. The programme was established in October 2002 following several Department of Health reports on IT Strategies for the NHS and aims to connect more than 8,500 general practices and their respective community health services in England to almost 300 hospitals and give patients easier access to their own personal health and care information.
Figure 5 outlines the original (2002) and the much expanded additional (2005) scope of the NPfIT plan and shows progress and daily usage statistics as of early 2008. It is clear that there is still a long way to go for the plan to be complete and for all objectives to be met. As of early 2009, while some systems were being deployed across the NHS, other key components of the system were estimated to be four years behind schedule, and others had yet to be deployed outside individual trusts.

The latest completion date for all systems to go live is 2014-2015 but the increased final cost of the programme, together with ongoing problems of management and the withdrawal of two of the original four IT providers have placed NPfIT at the centre of an ongoing controversy. The Commons Public Accounts Committee has repeatedly expressed serious concerns over its scope, planning, budgeting, and practical value to patients.

Figure 6 shows the final scope of the NPfIT and estimated usage statistics upon completion. It will be interesting to see how the US orchestrates system requirements, and contract negotiations on a scale much larger than NPfIT, which itself was considered, at the time it was launched, to be the “largest civil government IT project on the planet”.

The American approach seems to be to stimulate ‘demand’ at the sharp end for solutions, with patients and doctors.
Conclusion

Given the serious financial and resource implications of ageing populations, improved survival from a range of acute and long-term disorders, and the ever increasing array of treatment options now available, health services need to find new, more cost-effective ways of delivering care. Also of relevance are rising public expectations for accessible, timely and high quality care, and the associated epidemiological and health services work demonstrating considerable and at times very worrying variations in quality of care between healthcare providers, and threats to patient safety. In parallel with these demographic transitions and concerns about the future funding of health services, there have been dramatic advances in both hardware and software capabilities, such that technology now plays an integral part of the lives of most people in economically developed societies. It is the coming together of this need to find novel personalised cost-effective solutions and the development of technological capabilities that have created an environment in which the development of IT applications in relation to healthcare have been able to proliferate.
Given that these trends are, for the foreseeable future at least, set to continue and the considerable commercial interest associated with these developments, we anticipate that the number of IT solutions being developed and the range of conditions for which they may have a role and the speed with which they become available will continue to increase rapidly.

Major national efforts are underway across Europe and the US to promote more widespread and effective use of tools such as the electronic medical record (EMR) and computerised physician order entry (CPOE) systems. Although computerising clinical data and transactions can substantially improve information management in patient care, this automation reaches its full potential only when relevant clinical knowledge is combined with the data to inform care decisions and actions.

There is no doubt that clinical knowledge and patient-related information intelligently filtered as well as presented at appropriate times, and delivered using information systems — ideally with the electronic medical record as the platform — will finally make it possible to achieve large gains in performance, narrow gaps between knowledge and practice, and improve safety for all stakeholders. What remains to be seen is how fast we will go on this journey, and whether or not we will enjoy the ride. In any case, it will certainly be worthwhile.

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