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PERSPECTIVE

A surgeon's journey into the world of IT: the medwebtools.com database

RC Duvenage

Clinical Unit, Department of Surgery, Worcester Hospital, South Africa

Corresponding author, email: *riaanduvenage@icloud.com*

The need for quality data at Worcester Hospital became apparent in the early 2000s when monthly reporting of "surgical wound infections" was introduced by the hospital administration as a quality-of-care indicator in surgical wards. Nursing staff were tasked to capture the data, and an inordinate monthly number of "surgical wound infections" were reported directly to hospital management, who entered this into a provincial health information system. Closer scrutiny revealed a system designed without the guidance of surgeons that erroneously collected data on patients with soft tissue infection and diabetic foot sepsis and not as intended only those with surgical site infections. The lesson learnt was poor design means garbage in, and hence you will get garbage out. Clinicians should take the lead in monitoring their specialty-specific outcomes, by starting with a well-defined question and work backwards to enable database design.[1,2]

Realising the importance of quality data and the inability of provincial IT systems to provide specialty-specific data, the author began reading about surgical audit, health informatics, databases and website development. This became a journey of discovery with several lightbulb moments. My first attempt at data capture in 2001 was a paper-based standardised surgical documentation captured to MS Excel spreadsheets, which summarised significant clinical events.

In 2003, my first lightbulb moment occurred when I grasped the concepts of relational databases. A database that organises data into tables which can be linked based on data common to each. An MS Access database then replaced the spreadsheets and was designed to capture data of all discharged inpatients. This was a labour-intensive and unsustainable daily session of manual data capturing from the hospital folder into a database. The database was only accessible on a single desktop computer, and it became obvious for it to be sustainable, it had to be accessible from anywhere, and by other clinicians.

Simultaneously, the need for surgical management algorithms to assist doctors in district hospitals became apparent. In 2006, a static website called www.worcestersurgery.co.za was created for surgical management algorithms of common emergencies. Alas, it soon became clear that none of the referring doctors ever read the online management algorithms. This realisation led to another lightbulb moment that was to ensure compliance – the web-based clinical management algorithm should be the referral mechanism. If the referring doctor could select clinical parameters on the web algorithm, conditional logic could be employed to guide the next step. For example, "[clinical feature] present?" If yes, then action A. If no, then action B. Once mastered, the web forms led to the progression of the website from a static to a dynamic website which allowed the user to enter validated information into fields that is saved on a table in a web server's relational database.

Web forms paved the way since 2011 for the development of online surgical web-based "tools", so called because each performs several functions simultaneously: data capture, which is validated by built-in validation rules and provide clinical guidance through conditional logic, and used to (i) generate clinical notes, (ii) send conditional email notifications, (iii) populate different tables in the database that is included in pre-defined complex queries, and (iv) generate real-time graphs. The categories of Core web tools currently in use in surgery are for: (referral in) endoscopy and breast imaging; (in house) admissions, surgery outpatients department (SOPD) record, operation report, endoscopy report, discharge summary; (referral out) endoscopic retrograde cholangiopancreatography (ERCP), breast and gastrointestinal (GI) oncology medical diagnosis and treatment (MDT). A major key to success is that no data capturers are needed as data capture is by the clinician at point of contact as part of routine documentation.

Another lightbulb moment came after discovering CRUD software: *create, read, update and delete* – a database front end where users can view and, if permitted, edit clinical data stored in the database. This enables adding follow-up notes to a patient's initial clinical documentation submitted by a web form, for example, outpatient clinic notes. Utilising the CRUD software and the power of a relational database, clinical data is linked by hospital number which displays patient information online in a searchable table, with tabs indicating admission notes, operation reports and discharge summaries. The result is a user-friendly, intuitive, near fully electronic clinical documentation system that can be printed, whilst computable data, now totalling tens of thousands of patients accumulates in the database.

Clinical guidance has now been built into the surgical tools and includes an early warning system for sepsis,[3] referral criteria for ear nose and throat (ENT) patients, Centres for

Disease Control and Prevention (CDC) wound classification for accurate analysis of surgical site infections in operation reports, discharge summaries with ICD-10 coding and outcomes-based on the Clavien–Dindo complications classification,[4] and endoscopy requests based on the National Institute for Health and Care Excellence (NICE) indications.[5] Open source and customisable calendar software is used for appointments and theatre lists and are more effective than hardcopy appointment or theatre list books.

The latest lightbulb moment was the discovery of sophisticated database graphical user interface software, which can do complex structured query language (SQL) queries, yet another advantage of computable data.

The worcestersurgery.co.za website was further developed and later included similar clinical documentation tools for other specialties. In 2014, the project was moved to a new domain, worcesterhospital.org. Colleagues in other hospitals became interested and similar systems were designed for a few Cape Town hospitals, so a "hospital agnostic" name was sought and currently the project is hosted under the domain medwebtools.com. The latest development is a project with the Provincial Health Data Centre of the Western Cape, to automatically feed clinical data from the medwebtools.com server into a provincial health IT platform called Single Patient Viewer.[6] This project remains a non-commercial project that is owned, financed, developed and maintained by the author as a service to patients and colleagues.

In terms of the current technical aspects, the website front end programming languages include HTML 5, JQuery and Javascript. The server-side software includes a Linux-based operating system and MySQL database. Transferred data is encrypted and all emails use SMTP authentication. The website is protected by a firewall and login system. Access is role-based and restricted to approved healthcare workers. Auto-logout occurs automatically after a set time. Backups are done daily and software is updated regularly. Patient consent to electronic data capture is by an opt-out policy.

Having embarked on this journey, what are some examples of the fruits of my labours in terms of service delivery, policy and research? These include a standardised and sound clinical patient documentation and automatic email system, that adds a safety layer, enhances specialist oversight and ensures prompt discharge summary distribution. The CRUD software is used to effectively manage the emergency theatre list by enforcing a triage system whilst capturing theatre efficiency data.

The system has enhanced rural healthcare referrals and interaction. Equally important, it has allowed us to accurately monitor our burden of disease to inform health policy and conduct research. Since 2014, 18 publications in peer-reviewed journals and one completed M.Med. dissertation in Internal Medicine have resulted from the analysis of our data. Three M.Med. dissertations in surgery are in progress. The datasets have led to ongoing participation with the Global Surgery division of Stellenbosch University, and a combined effort to address district surgical services.

Any e-health system is only part of the solution to healthcare system problems. Successful implementation depends on leadership, management and institutional culture. E-health solutions that enable specialty and institution-specific audit and research cannot be achieved by enterprise level deployment and provincial rollout of generic e-health systems. Bespoke web-based and clinically focused e-health systems are highly effective, and the focus of information management in the state health sector should be to acknowledge and encourage such innovations and facilitate processes to enable systems such as medwebtools.com to act as data feeder systems for enterprise-level health information systems.

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