Seeking solutions: scaling-up audit as a quality improvement tool for infection control in Gujarat, India

MANJU M. ANCHALIA1 AND LUCIA D’AMBRUOSO2,3

1Civil Hospital, Asarwa, Ahmedabad, Gujarat, India, 2Initiative for Maternal Mortality Programme Assessment (Immpact), Section of Population Health, University of Aberdeen, Aberdeen, UK, and 3Centre for Global Health Research, Umeå University, Umeå, Sweden

Address reprint requests to: Lucia D’Ambruoso, 17D Baker Street, Aberdeen, AB25 1UQ, UK. Tel: +44-7779-038345; Fax: +44-1224-555704; E-mail: ldambruoso@gmail.com

Accepted for publication 20 February 2011

Abstract

Quality problem or issue. Surgical-site infections (SSIs) give rise to significant demands on the health systems as well as economic and social sequelae for patients. This article describes an audit for infection control developed in a surgical unit of a tertiary care setting in Gujarat state, India that was scaled up to all state-owned hospitals in the district.

Initial assessment. A retrospective baseline assessment of surgical infection rates in a general surgical unit revealed an infection rate of 30%.

Choice of solution. An audit was implemented based on guidelines for SSI prevention published by the Centres of Disease Control.

Implementation. Surveillance and hospital epidemiology were established and practice reforms implemented. Monthly and annual meetings to review implementation were held.

Evaluation. After 12 months, an 88% decrease in the infection rate in the surgical unit was demonstrated. Thereafter, the process was replicated across the surgical department and for all cases undergoing surgery. After 12 months, a 67% reduction in the infection rate was detected. The process has since been applied across the state.

Lessons learned. A locally owned and team-led process embedded within routine working conditions can challenge widely held perceptions, inform low-cost and no-cost remedial actions, and improve cultures of practice, quality of care and health outcomes. As urban populations grow, methods that are capable of continuously identifying, and responding to, problems and sustaining quality of care in facilities are necessary. SSIs may be largely preventable. With careful implementation, audit has the potential to be a major contributor to their reduction.

Keywords: audit, surgical-site infection, infection control, India

Quality problem or issue

Erman et al. [1] established that not only are surgical-site infections (SSIs) the most severe complication in patients post-surgery, but are also the most common. SSIs also give rise to increased rates of adverse health outcomes, lengths of hospital stay and costs [1]. Similarly, Bratzler et al. found that patients that develop SSIs are 60% more likely to be admitted to the intensive care unit at least once, five times more likely to be admitted multiple times, twice as likely to die than patients that do not develop SSIs [2]. SSIs are an important public health problem with marked consequences for the health systems and long-term economic and social sequelae for patients. Due to the burden of SSI, effective approaches for infection control should be developed. This article describes an infection control audit developed and scaled-up from a single surgical unit to all state-owned hospitals in Ahmedabad district in Gujarat state, India.

Now at 1.2 billion citizens, India is the world’s second most populous country [3]. A socialist, secular and democratic republic, India is a state of marked transition and contradiction. Despite being one of the fastest growing economies in the world, poverty and ill-health persist. Although improvements in life-expectancy, infant, neonatal and under-five mortality have been demonstrated recently (Table 1), Government health goals have not been met and...
Table 1 Selected demographic and health indicators for India and Gujarat State [3]

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Life expectancy (years)</td>
<td>55.5</td>
<td>60.3</td>
<td>63.2</td>
</tr>
<tr>
<td>Infant mortality rate (per 1000 live births)</td>
<td>110</td>
<td>80</td>
<td>60*</td>
</tr>
<tr>
<td>Under 5 mortality rate</td>
<td>152</td>
<td>94</td>
<td>73</td>
</tr>
<tr>
<td>Neonatal mortality rate</td>
<td>70</td>
<td>51.1</td>
<td>40</td>
</tr>
<tr>
<td>Maternal mortality rate</td>
<td>NA</td>
<td>NA</td>
<td>407</td>
</tr>
<tr>
<td>Crude birth rate</td>
<td>33.9</td>
<td>29.5</td>
<td>24.8*</td>
</tr>
<tr>
<td>Crude death rate</td>
<td>12.5</td>
<td>9.8</td>
<td>8.0</td>
</tr>
<tr>
<td>Total fertility rate (per 1000 population)</td>
<td>4.5</td>
<td>3.6</td>
<td>3.0</td>
</tr>
</tbody>
</table>

*2003 data.

progress is slower than that of other South Asian countries such as China and Indonesia [4].

The state of Gujarat is served by a tiered health system consisting of a private sector, public and government hospitals, community health centres/rural hospitals and primary health centres [3]. Much of this infrastructure functions poorly due to serious shortages of health professionals, poor hygiene and overcrowding [5]. SSIs account for considerable morbidity and mortality [6], with infection rates noted as high as 30% in some locations [7].

The audit described in this article was implemented in a tertiary level facility in the city of Ahmedabad, a notable example of proliferating urbanization in India. With a population of nearly 6 million, Ahmedabad is one of India’s largest cities.

Audit can be defined as ‘the process of reviewing the delivery of health care to identify deficiencies so that they may be remedied’ [8]. Clinical audit is well established in industrialized countries, with examples dating from the turn of the 19th century [9]. Although the market of new drugs, technologies and larger health workforces have contributed to health improvements in these settings, audit, and allied methods, are also thought to be an important contributor [10]. Although clinical audit is often characterized by fault-finding and blame [11–12], evidence is emerging that, with careful implementation, the demotivating effects and negative perceptions that surround audit ‘can be overcome...to develop a positive, content specific, and therefore acceptable, process’ [13].

Allied methods such as maternal death reviews, confidential enquiries, criterion-based clinical audit and verbal autopsies have been implemented in a diverse range of low-resource settings in Asia [14–15] and Africa [16–18] recently. As well as discrete research studies, more sustained and locally owned audit processes have also been implemented in South Africa [19], Egypt [20] and Malaysia [21] in recent years.

In this article, we describe an audit process developed by and for a single surgical unit in a tertiary care setting. We describe the audit’s inception, design, effects, replication and factors behind its success. The article responds to calls for the documentation of audit [22–23] and contributes to the literature on audit implementation in low-income settings.

Initial assessment

The hospital in which the audit originated can be described as follows:

The Civil Hospital in Ahmedabad is just like any other general hospital of India, attached to a medical college. Poor hygiene, overcrowding, and workload disproportionate to manpower and facilities is common. Patients, most belonging to low socio-economic status, are undernourished, anaemic, hygienically poor and uneducated. Operating theatres are overused with little time for routine maintenance and there are frequent breaches in aseptic techniques.

In 2001, surgical infection rates came under scrutiny in a 60-bed general surgical unit in the Civil Hospital of Ahmedabad following infections of clean cases. Initial discussions revealed beliefs among senior specialists that infection rates were low, that routine prophylactic antibiotics were effective and that infected cases were due to poor infrastructure, inadequate processes and the actions of health staff. There was also a common perception that infection rates could not be controlled. To determine the true extent of the problem and to address it, an SSI audit team was convened consisting of one consultant, two residents; one nurse and an auxiliary.

An initial, retrospective baseline assessment (August 2000–October 2000) revealed an infection rate of 30%, markedly higher than widely thought. In response, the team developed and implemented a routine audit process.

Choice of solution and implementation

The process was designed according to the infection control guidelines published by the US-based Centres for Disease Control (CDC) [24] and a review of the literature. On the basis of 20 years of meta-data, the CDC guidelines set out comprehensive recommendations for SSI prevention that relate to basic infection control and hygiene for the pre-, intra- and post-operative periods, and surveillance. The CDC guideline ranks each recommendation on the basis of ‘existing scientific data, theoretical rationale and applicability’ [24] (Table 2). Recommendations to reduce SSI risk that were strongly recommended with experimental, epidemiological or clinical evidence and/or a strong theoretical rationale (i.e. all that were ranked IA and as IB) were adopted. The committee implemented and monitored these recommendations using the approach described below.

Surveillance and hospital epidemiology

Patients undergoing surgery (major or minor) were followed up for 1 month post-operatively (1 year for prosthesis) using a SSI definition to identify cases developed for the audit (Box 1). Where infections were identified, wounds were inspected and culture and sensitivity investigations conducted. For identified cases, a Patient Infection Card was used to record patient characteristics (sex, age, weight, height, medical illness
and so on) and details of relevant care and procedures (pre- and post-operative antibiotics, pre-operative hygiene, class and duration of surgery, wound examination, infection, culture and sensitivity information). Systems were introduced to pool these data and to calculate infection rates according to various risk factors (wound classification, mode of surgery, length of pre-operative stay, duration of surgery, nutritional status, operating surgeon, medical illness and organisms cultured).

**Box 1 Surgical-site infection, a definition [5]**

Infection occurs within 30 days after surgery (if an implant is left in place, to 1 year) if related to surgery and at least one of the following:
- Purulent drainage from wound/drain (culture documentation not required)
- Organisms isolated from fluid/tissue of the wound
- At least 1 sign of inflammation (e.g. pain or tenderness, induration, erythema, local warmth of the wound)
- Spontaneous dehiscence of wound or deliberate opening of the wound by surgeon unless site culture result is negative
- Surgeon or attending physician declares the wound infected
- Identification of abscess in the organ/space/incision site is identified by direct examination or during reoperation, by histopathology, or by radiological examination

**Practice reforms**

Practice reforms focussed on the widespread use of prophylactic antibiotics. Existing regimens were replaced with reduced antibiotic schedules and prophylactic antibiotics were recommended to be given only in the operating theatre at the time of induction or directly before an operation. Combinations of antibiotics were also avoided. Other practice reforms included having patients bathe and wear clean clothes pre-operatively, controlling diabetes and other co-morbidities pre-operatively, using iodine scrubs to prepare operative areas, replacing shaving of hair in wards with limited clipping in theatres, strict implementation of aseptic techniques, haemostatic dissection, wound closure monitoring by senior surgeons, avoidance of frequent post-operative dressings of clean wounds, wound surveillance and shortening of hospitals stays.

**Meetings and feedback**

Monthly meetings, attended by unit staff and the ward sister, were held to review the implementation of the recommendations generated. In meetings, detailed discussions were held on the SSI rates of different categories and for each case identified, avoidable factors and substandard care were established and corrective measures developed. Guidelines and protocols were developed, reviewed and updated where necessary, and the implementation of recommendations was monitored in an ongoing fashion. Annual meetings were also held where surveillance data were presented to surgeons, ward, nursing
and theatre staff, and ward assistants from the department. Through these mechanisms, staff were informed about patients with SSIs and sensitized to issues including personal hygiene, sanitation, pre-operative preparation of patients, etc. Otherwise, the audit focused on systems improvements, made deliberate attempts to encourage the active involvement of all members of the team and avoided fault-finding among individual staff members.

**Observations, evaluation and scale-up**

The initial audit had to challenge widely held perceptions and beliefs among, often senior, staff. In the early audit meetings and discussions, poor infection control and high infection rates were attributed to the actions of ‘other’ health staff or insufficient supplies and equipment, i.e. circumstances outside the control of individuals. And, initially, the accuracy of the data from the surveillance system was questioned by surgeons. There was also some resistance to changing existing practices such as hair removal in theatres rather than wards, prophylactic antibiotics at the induction of anaesthesia and no antibiotics post-operatively in clean cases. As the audit progressed and involved different cadres of staff however, a shared understanding of, and, crucially control over, whole-site processes developed. Gradually the practice reforms were adopted and faith in the audit data grew among surgeons. The involvement of different cadres of staff also gave rise to habitual change. These changes in attitudes and culture were not, and indeed do not, lend themselves to be, empirically measured but were clearly observed.

An additional early, and perhaps more tangible, result of the process related to these systems-changes were improved interactions with the microbiology section. Prior to the audit, laboratory reports to study microbial flora and establish antibiogram profiles were often unreliable, with, for instance, contaminated swabs producing false positives. False negatives were also common. The audit helped to address this; swabs were monitored and cultures and laboratory reports could be requested and repeated, which facilitated more accurate determination of resistance patterns.

Perhaps the most tangible effect of the audit was that, after 12 months, the surveillance system demonstrated a decrease in the infection rate from 30 to 13%, a 56% reduction. By the surveillance period (Aug 2003–May 2004), an 88% decrease in the SSIs rate to 3.5%, was detected. This result is described in detail elsewhere [5].

Following the 2004 publication of the reduction in SSI rates, confidence was instilled to replicate the process elsewhere. After an extended sensitization period (with meetings, workshops, seminars and by capitalizing on the adoption of the process by key stakeholders), in 2007, the original audit system was implemented across the entire surgical department (300 beds) and for all cases undergoing surgery (~460 surgeries per month). After 12 months of the departmental audit, infection rates dropped from 16.9 to 9.0% (August 2007–March 2008) and again to 5.6% (July 2008) (Table 3). As a result, the audit was applied to the entire hospital: over 2000 beds and 19 departments. At the time of writing, publicly available data are not available from the hospital audit, although preliminary data have indicated an SSI rate reduction from 13% (August–September 2007) to 5% (2008) to 4.4% (January–June 2009).

As the process was adopted across sections and departments, the original approach, particularly the surveillance system, had to diversify to suit the needs of different departments such as orthopaedics, paediatric surgery, neurosurgery etc., and the initial system was modified for this purpose. By May 2008, a standard audit protocol was finalized with the necessary applicability for different departments.

In addition to surveillance, regular feedback quickly became a crucial element of the process. Routine reports, with infection rates generated from the surveillance systems, were circulated to all levels. At the department level, where high infection rates were found, routes for intervention were discussed, agreed and implemented among all levels of staff. Acknowledgments and praise were given where low rates were established. Higher-level meetings with heads of departments and units were also introduced and held on a quarterly basis, as were biannual and annual meetings at hospital commissioner of health and family welfare level, respectively. These meetings, combined with the public reports, became useful routes by which to increase awareness and garner resources for reform.

In parallel to the scale-up of the infection control audit in the Civil Hospital, in 2007, the state government and health department introduced a policy of hospital acquired infection (HAI) control. Under this policy, the director of medical education became responsible for the implementation of a district-wide HAI surveillance system. To develop this system, the audit process described earlier was adopted in all six state government tertiary hospitals.

The results of the district surveillance, using the original audit systems of systematic recording and reporting, detected an infection rate of 13% (August–December 2007). This was presented to hospital and government management committees in late 2007. The meeting precipitated action. The need to improve infrastructure for infection control was recognized and budgetary allocations were sanctioned by Health and Family Welfare Department. This involved the allocation of significant resources for the renovation of operation rooms, upgrading of central sterilizing services department, sanitation services, recruitment of manpower etc.

At the time of writing, the process is ongoing in Gujarat State hospitals. Medical superintendents now send the monthly HAI/SSI data, generated through the surveillance system, to the director of medical education. In addition, the

<table>
<thead>
<tr>
<th>Surveillance period</th>
<th>Infection rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>August 2007</td>
<td>16.9</td>
</tr>
<tr>
<td>March 2008</td>
<td>9.0</td>
</tr>
<tr>
<td>July 2008</td>
<td>5.6</td>
</tr>
</tbody>
</table>
commissioner of health and family welfare also monitors the HAIs of all hospitals in the state and audit results; reports and recommendations are discussed and implemented quarterly between the Director of Medical Education Research and the Commissioner of Health and Family Welfare. These systems allow routine reporting and problem identification to monitor the effect of remedial actions implemented.

Lessons learned

Several inter-related factors were crucial to the success of the audit. First, and perhaps most significant, was the robust and integrated surveillance system that tracked and demonstrated progress. This, in turn, depended on the efforts of administrative and clinical staff and commitments to hospital epidemiology. Ensuring support from these individuals and sections was critical, albeit sometimes difficult for busy staff. As the process became legitimized, normative perceptions of morbidity causation were challenged as was a general ambivalence and reluctance to acknowledge and address shortcomings. An effective routine surveillance system was therefore critical.

Regular, positive feedback and a team-approach were also critical to address the negative and punitive associations typical of audit and helped to foster positive accountability. The philosophy underpinning this was that each member of staff, ‘from the sweeper to the surgeon’, had an important and equivalent role to play in infection control. This helped to forge links between sections and increased awareness, collective-responsibly and a sense of control among staff.

It is noteworthy that, even as the audit process demonstrated progress and was scaled-up, some departments and units remained, at least initially, unwilling to implement it. It has been a gradual process to convince staff to have the courage to accept failings and address problems. The influence of a few key actors was an important additional catalyst in the establishment of audit committees in different departments, and negotiation, bravery and perseverance were necessary.

The scaled-up surveillance system now allows HAIs/SSIs to be monitored in a district-wide process involving high-level government and management groups, and the findings generated and published have considerable political leverage. The recommendations for practice have been incorporated into the National Accreditation Board for Hospitals and Healthcare Providers (NABH) practice guidelines from the Quality Control Council of India. A further crucial factor is therefore high-level political recognition of the problem, providing opportunity for action. It is also critical that a successful and established process was available (from the original audit), which presented a solution to the problem. This possibly made HAIs/SSIs a more attractive political issue to tackle, i.e. due to the likelihood of it being successfully resolved [25].

Broader implications

There are three ‘levels’ of broader implications. At the local level, and in terms of future directions, there are plans to synthesize the results from various departments and hospitals to generate powerful meta-data for service-planning. It is worth considering that, if further expansion were implemented with facilities adopting the audit in a phased fashion, then a cluster-randomized controlled trial with meta-analysis to demonstrate effect through an experimentally designed study may be possible. It should be noted, however, that many of the effects (e.g. attitudinal and cultural changes, learning outcomes, motivation and a team-approach etc.) are not amenable to quantification or empirical demonstration and are more process-based, lending themselves to descriptive accounts like those provided above.

Secondly, and more generally, our experience demonstrates how a locally developed process has the potential to become a sustainable solution. Infection control addressed with audit may offer an ‘entry-point’ for systems strengthening of contextu-lized. It is of critical importance that the recommendations are not always related to new technologies, but also address norms, perceptions, attitudes and cultures of practice among staff, as well as infrastructures, adopting a team approach of how to implement known technologies effectively. As a result, remedial actions such as early discharges impact not only on hospitals and systems costs but also on phenomena such as individual earning capacity. It is reasonable to infer that a ‘cascade’ of financial and social benefits may result from the reforms and service improvements implemented.

Finally, this experience converges with a growing body of theoretical and empirical evidence of the benefits of audit in low-income settings [22, 26–27]. Contemporary public health debates suggest that the examination of episode-based inter-actions and experiences give rise to more contextually relevant information on how to improve services, and that strengthening local capacity for effective and sustainable implementation of known strategies is both possible and urgently needed [28–29]. Audit, based on principles of participation, coupled with a locally led and inter-disciplinary team, generating routine, integrated surveillance data and effective discussion and dissemination of results, has the potential to improve practices and quality of care, and can garner significant and sustained political and financial support.

The consequences of poor infection control include long-term sequelae for patients, increased demands on already inadequate health resources, and low overall quality of care. A leading scholar, noting the relationships between context and condition, recently stated that HAIs have the potential to be ‘more frequent and serious in developing countries where lack of resources and basic facilities for infection control combine with patients being more susceptible’ [30]. Despite this, our evidence suggests that with dedicated and careful implementation, capitalizing on expert, local knowledge through a locally owned and locally sustained process, audit has the potential to make considerable contributions to the reduction of SSIs. As urban populations grow, tertiary healthcare facilities must develop methods that are capable of
accurately identifying and responding to problems and sustaining quality of care at systems level.

Authors’ roles

M.M.A. designed and led the ICC from its original inception in 2001 and throughout scale up. L.D. conceived of, prepared and drafted the manuscript.

Acknowledgements

The manuscript was prepared on behalf of the Civil Hospital Infection Control Committee. The authors acknowledge the efforts of all those who implemented the audits at unit, department and hospital level and who made substantial intellectual contributions to the process: designing and leading the collection, analysis and validation of data, devising training and implementation schedules and modifying the study design during scale-up. Staff also wrote policy documents and infection control manuals. The authors also acknowledge the infection control committee members: Dr G.H. Rathod, Dr Sood Nidhi, Dr Gautam Vinod, Shital Chauhan and audit team members: Shital Parmar (assistant matron), Dr Gautam Sharma and Chakti Sharma (assistant hospital administrators) and Smita U Panchal, S.R. Patel, W.B. Patel, D.J. Dabla, S.A. Tirthdasani, PH. Patel, K.P. Amin (nurses). The authors would also like to acknowledge Professor Dileep Mavalankar and the team at the Indian Institute of Management in Ahmedabad (IIM-A), Gujarat for sharing insights and facilitating documentation of the audit, and Dr Julia Hussein, who led a needs assessment of the prevention and management of puerperal sepsis during labour and delivery in health facilities in Gujarat State, from which this case study arose.

Funding

This work was supported by a study entitled ‘Using infection control as an entry point for improving the quality of delivery care and strengthening health systems in developing countries’ which is funded by the MacArthur Foundation. More broadly, the work was undertaken with the Immpact Research Group, originally funded by the Bill & Melinda Gates Foundation; the UK Department for International Development (DFID); the European Commission and; the United States Agency for International Development (USAID). The funders have no responsibility for the information provided or views expressed in this paper. The views expressed are those of the authors.

References


