Assessing antibiotic stewardship using the surgical site infection prevention bundle

ABSTRACT

Background: Antibiotic prophylaxis is crucial in head and neck surgery to prevent infection from clean contaminated wounds. Scottish Intercollegiate Guidelines Network (SIGN) guidance, the gold standard of practice, recommends that administration of broad spectrum antibiotics is discontinued after 24 hours post-operation. A three-audit cycle quality improvement project was conducted to assess clinical practice against SIGN guidance at a large London teaching hospital.

Methods: Three change initiatives were implemented to improve antibiotic stewardship. First, an update of Trust guidelines with an associated poster campaign to educate staff and improve awareness. Second, introduction of a specific 'prophylactic antibiotics in head and neck surgery' bundle on the electronic hospital-wide prescribing system. Third, an update to an antibiotic prescribing guide (Microguide).

Results: Over a 3-year study period the number of patients receiving antibiotics beyond 24 hours declined significantly (88% in 2015, 76% in 2016, 25% in 2018), demonstrating improved compliance with SIGN guidelines overall. Despite this, staff documentation of indications for extended antibiotic use remains suboptimal (58% in 2016 and 44% in 2018) as does the number of specimens sent for microbiological analysis (52% in 2016 and 0% in 2018).

Conclusions: Appropriate prophylactic antibiotic prescribing can improve morbidity and mortality rates in head and neck cancer patients. Three change initiatives have been demonstrated which can help to improve prescribing compliance in line with SIGN guidance. Ongoing auditing is required to maintain the longevity of improvements made and encourage staff documentation of indications for extended antibiotic use and microbiology specimen analysis.

Scottish Intercollegiate Guidelines Network (SIGN) guidance recommends administration of broad spectrum antibiotics as prophylaxis in patients undergoing head and neck surgery for not more than 24 hours post-operation (Scottish Intercollegiate Guidelines Network, 2014). University College London Hospital guidelines recommend that prophylactic antibiotics should be used at induction of anaesthesia or 30 minutes before skin incision. Furthermore, prophylactic antibiotics should be discontinued 24 hours after completion of surgery, with additional antibiotic-specific intraoperative dosing if surgery time is longer than 4 hours or blood loss is more than 1500 ml. A quality improvement project was performed to evaluate current practice at University College London Hospital against the SIGN guidelines.

Background

Head and neck cancer comprises 4% of all malignancies. Surgery remains the main curative intervention for most head and neck cancer patients (Skitarelić et al, 2007). However, this type of surgery carries an additional risk of microbial contamination because of the involvement of the mucosal surfaces of the oropharynx and the upper aerodigestive tract, which create a clean contaminated surgical wound (Yang et al, 2013).

Procedures associated with increased infection risk secondary to clean contaminated wound status include radical or bilateral neck dissections, and reconstruction with myocutaneous or microvascular free flaps. Consequently, prophylactic antibiotic use to minimize infection rates is a key component in optimizing patient outcomes and preventing surgically associated morbidity and mortality. In the absence of prophylactic antibiotics, infection rates are considerable, affecting between 24 and 78% of all head and neck surgical cases (Simo and French, 2006). It is believed that prophylactic antibiotic use can reduce this infection risk by 5–38% (Skitarelić et al, 2007). This makes effective antibiotic stewardship within head and neck departments a clinical imperative.

Baseline measurement

An initial audit identified that 88% of patients undergoing head and neck surgery for cancer received a prolonged course of prophylactic antibiotics (more than 24 hours), with 86% of these patients having no documented evidence of infection. The initial audit also found that this was because of a reluctance to discontinue antibiotics early as a result of conflicting evidence and a lack of clear guidance regarding the appropriate duration of prophylactic antibiotics.

Design

This study is a retrospective case note review of changes following quality improvement cycles in patients undergoing major oncological and reconstructive surgery for head and neck cancers from February to May

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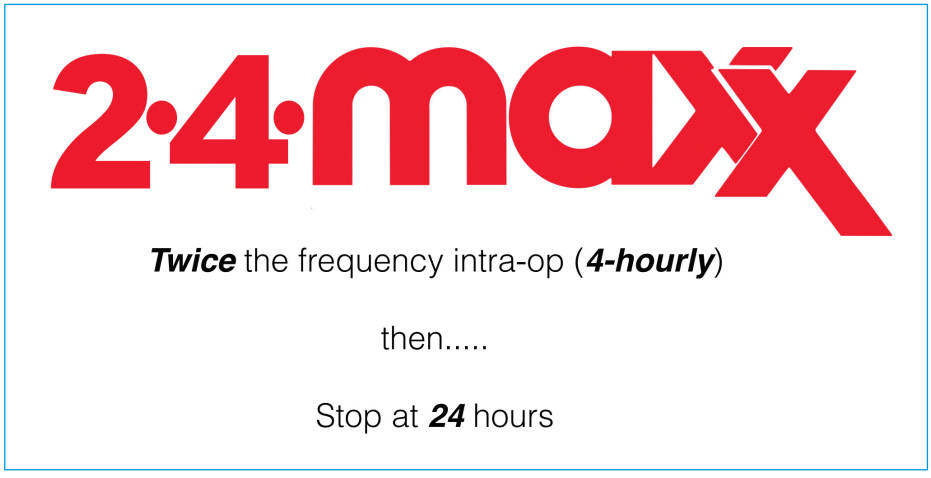

Figure 1. University College London Hospital prophylactic antibiotics prescribing poster.

2015, 2016 and 2018. The electronic and medical case notes and the online prescribing system were reviewed. Audit information was uploaded onto an online password-encrypted audit proforma, after patient identifiable data were removed. When medical notes were made available, further information was gathered on perioperative antibiotic prescribing and administration, redosing schedules of antibiotics intraoperatively and compliance with current antibiotic guidelines in head and neck cancer surgery. Any clinical and laboratory evidence of health-care-associated infection was also recorded.

The surgical procedures which were included were mandibulectomies, partial or total laryngectomies, resection of pharynx or trachea, neck dissection and flap reconstruction. Excluded procedures were any surgery for benign diseases or non-curative or symptom resolution surgery, such as thyroid and salivary gland excision without lymph node dissection, transoral resection without neck dissection, and flap reconstructions.

Strategy

This service evaluation project was performed in line with national initiatives. The SMART (specific, measurable, achievable, relevant, timely) objectives were to encourage prudent prescribing and improve antibiotic stewardship across a three-audit cycle quality improvement project. Improvements were modelled on the plan, do, study, act (PDSA) cycle, whereby ideas are planned, tested, the outcomes observed and modifications made in a structured manner.

Cycle 1

The SIGN (2014) guideline recommendations are based on evidence from Russel and Goldberg (2012), who reviewed three randomized controlled trials looking at ideal length of prophylactic antibiotic use and found no added advantage of extending prophylaxis beyond 24 hours. Subsequently, a large-scale single centre retrospective review suggested that the use of ampicillin/sulphabactam beyond 24 hours may protect against surgical site infection in patients undergoing major head and neck surgery (Langerman et al, 2016). This has led to confusion among health-care professionals regarding the appropriate management of head and neck surgical patients.

The first change initiative sought to directly address conflicting medical opinion by creating specific Trust guidelines on the use of prophylactic antibiotics to reduce wound infections rates in head and neck patients (see supplementary figure on www.bjhm.co.uk). To increase awareness of these guidelines among staff, a poster campaign was designed (*Figure 1*), which was extensively displayed in the hospital's anaesthetics rooms and theatre corridors.

Cycle 2

The online prescribing system EPMA was first introduced at University College London NHS Trust in November 2015. Anaesthetists (and other doctors) are required to record all prescriptions and administration of drugs using this platform. EPMA is still a relatively new system, and the results suggested, for the first time, that the prevailing practice within University College London Hospital was to record intraoperative antibiotic prophylaxis on the anaesthetic chart alone. This formed the basis of the second service improvement idea, which was to optimize antibiotic stewardship by enhancing uptake of EPMA prescribing. An antibiotic prescribing bundle was therefore developed in line with the new Trust guidelines and embedded within the EPMA prescribing system following consultation with information technology engineers.

Cycle 3

It was noted that Microguide, an application for Android phones and tablets, which summarizes local guidelines for all antibiotic use (including surgical prophylaxis), did not include details of the Trust's guidelines on intraoperative redosing schedules. Microguide is used widely among staff at University College London Hospital, and it was hypothesized that the non-inclusion of these guidelines in this application may be contributing to the observed discrepancies in practice among anaesthetists. This was addressed by updating Microguide with the intraoperative redosing schedules (*Figure 2*) to support staff understanding and compliance – thereby forming the third change initiative.

Results

Audit 2 took place after PDSA cycle 1 (development of the Trust guideline and the associated poster campaign). A total of 25 patients underwent major head and neck surgery during the study period. Medical case notes were available for 23 patients, but electronic information was available for all patients.

Re-audit found that 100% (n=25) of patients received intravenous antibiotics at induction of anaesthesia, but only 44% (11/25) of the patients had their antibiotic prescription documented in EPMA (the trust's online prescribing system) – the remaining doses (56%; 14/25) were recorded on drug cards kept in the patients' case notes.

A total of 76% (19/25) of patients received antibiotics for more than 24 hours after their surgery – against SIGN guideline advice – and 63% (12/19) of patients were given incorrect intraoperative antibiotic redosing schedules. Of the non-SIGN compliant patients (76%), clear clinical indications for extended antibiotic therapy were identified

in 58% (11/19) of cases. However, only 53% (10/19) of patients receiving antibiotics after completing surgical prophylaxis had samples sent for microbiological diagnosis to guide this extended therapy. Ongoing prolonged antibiotic use and inconsistences in antibiotic course duration were identified.

The final audit (audit 3), which assessed a total of 28 patients, focused on evaluating consistency and minimizing variance in antibiotic prescribing following upgrades to EPMA and Microguide (PDSA cycles 2 and 3). While electronic notes were obtainable in all cases, case notes were not available for four patients.

A total of 36% (10/28) of cases were prescribed prophylactic antibiotics within 24 hours as per SIGN guidelines, and 25% (7/28) of cases received antibiotics beyond 24 hours against SIGN guidelines. Only 44% (8/18) of SIGN non-compliant case notes had documented reasons for antibiotic continuation. 0% (0/28) patients had microbiology specimens sent for analysis. Audit 3 found that 57% (16/28) of patients received prophylactic antibiotics at induction and 36% (10/28) did not; the remaining 7% (2/28) had these details missing as a result of lack of case note availability. In summary, although audit 3 showed improved compliance with the SIGN guideline recommendations, staff documentation of indications for prolonged antibiotic use and microbiological specimen analysis rates were reduced.

Compliance with the SIGN guidance increased across all three audits (*Figure 3*). Where patients required extended antibiotic use, this was also increasingly likely to be documented because of the change initiatives.

Lessons and limitations

The overall aims of this retrospective review of changes following improvement cycles were:

1. To understand prophylactic antibiotic prescribing within a head and neck centre of clinical excellence
2. To introduce novel methodologies to enhance compliance with national SIGN guidelines
3. To monitor and improve prescribing practice over a 3-year study period.

By accomplishing these aims, the authors have delivered a rigorous framework for understanding and monitoring antibiotic stewardship within a clinical setting. Contextually, these findings contribute significantly to the current literature which highlights perioperative antibiotic prophylaxis (Brink et al, 2017) and documentation in medical notes (Parwaiz et al, 2017) as key concerns within the field of quality improvement. The authors hope that these recommendations will be used within other departments and hospital settings, nationally and internationally, to improve patient outcomes.

Reliable data capture and standardized outcome measure is the foundation of quality improvement, and this proforma held on trust computers enabled secure, reliable and consistent data collection for comparison of audit data generated across 3 years. At the time of collection, data were presented at the monthly departmental clinical governance meetings, providing a platform for interdisciplinary discussion and an opportunity for staff to suggest change initiative solutions which proved highly original and creative. While the power of this single centre study is small, the authors hope this work highlights the value of high-quality data capture and multidisciplinary collaborative innovation.

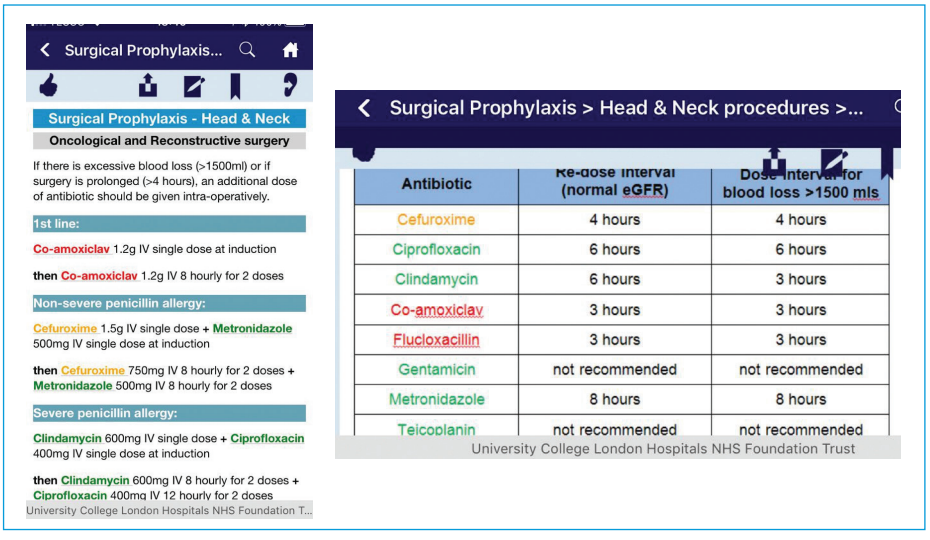

Figure 2. Screenshot of Microguide University College London Hospital surgical prophylaxis updates in patients undergoing surgery for head and neck cancer.

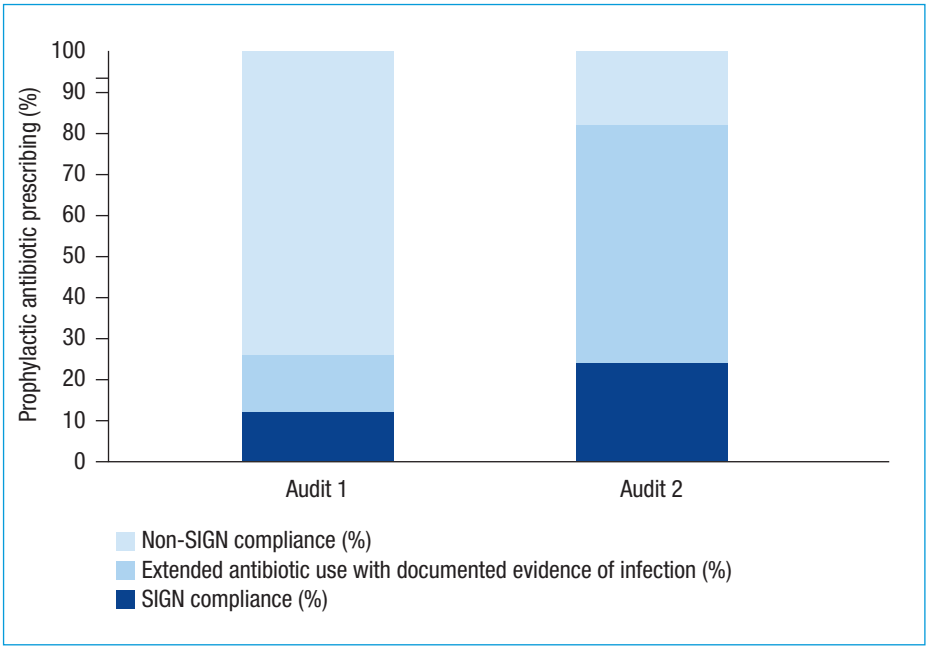

Figure 3. Rate of prophylactic antibiotic prescribing across three consecutive audits. SIGN = Scottish Intercollegiate Guidance Network.

KEY POINTS

- Antibiotic prophylaxis is important in establishing good clinical outcomes in head and neck surgery.
- Scottish Intercollegiate Guidelines Network guidance recommends administration of broad spectrum antibiotics as prophylaxis in patients undergoing head and neck surgery for not more than 24 hours post-operation.
- Prescribing practices can be improved by updating trust guidelines, providing electronic prescribing bundles and using mobile phone apps which advise on microbiology.

There are limitations that warrant discussion. Despite a trend towards an overall improvement in antibiotic stewardship, the sample size was small and incorporated just one heterogeneous surgical sample, and the absence of a statistical analysis reflects this. Furthermore, although the study is comprehensive over 3 years, it is still retrospective and thus prone to information bias. The authors would recommend prospective audits as an efficient, low-cost and easily scalable method for future antibiotic stewardship audits.

Conclusions

Antibiotic prophylaxis is an important factor in establishing good clinical outcomes in head and neck surgery. Service improvement initiatives such as trust guideline development, electronic prescribing bundles and using mobile phone apps which give updates on microbiology advice can help to improve awareness of staff and ultimately compliance with national SIGN guidelines. As ever, changing established human behaviour remains a significant challenge to optimizing quality improvement initiatives; as such, the authors recommend ongoing audits of frontline service provision to ensure change sustainability following PDSA cycles. **BJHM**

The authors would like to acknowledge the valuable contribution of the University College London Hospital anaesthetics, microbiology and head and neck departments. Ethical approval: The project was registered with the clinical governance lead. Advice from the Joint research and development department was sought and an ethical waiver was obtained. In addition, the Caldicott Guardian was informed of this study and clearance was given to proceed. Conflict of interest: none.

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Reducing infection in head and neck surgery

University College London Hospital has new guidelines to reduce wound infections in head and neck surgery patients

	Antibiotic	Intraoperative	Postoperative
First line	Co-amoxiclav	1.2 g on induction, then 4-hourly	2 postoperative doses (1.2 g at 8 and 16 hours after induction)
Second line (mild penicillin allergy)	Cefuroxime and metronidazole	Cefuroxime: 1.5 g on induction, then 750 mg 4-hourly Metronidazole: 500 mg on induction, then 8-hourly	2 doses of each (750 mg/500 mg at 8 and 16 hours after induction)
Third line (severe allergy)	Clindamycin and ciprofloxacin	Clindamycin: 600 mg intravenous, ciprofloxacin: 400 mg intravenous on induction	2 doses of each at 8 and 16 hours after induction

MORE THAN 24 HOURS OF POSTOPERATIVE ANTIBIOTICS CAUSE MULTI-RESISTANT INFECTIONS

FAQ:

1. Why is co-amoxiclav first line - don't cefuroxime and metronidazole cover more anaerobes?

Co-amoxiclav is first line at University College London Hospital and covers all likely organisms as effectively as cefuroxime and metronidazole. It is simpler to give, especially for long operations, since it is just one 4-hourly dose, rather than cefuroxime 4-hourly and metronidazole 8-hourly.

2. Why such frequent doses intraoperatively? Isn't that bad for the kidneys?

Plasma levels must stay high while the tissues are open. There is no harm giving co-amoxiclav every 4 hours if the estimated glomerular filtration rate is more than 30 ml/min/1.73 m^2 (if in doubt, call pharmacy)

3. How come only 24 hours postoperatively?

Longer courses cause multi-resistant infections, such as

- Meticillin-resistant *Staphylococcus aureus* or *Clostridium difficile* (3x risk)
- Multi-resistant infections (3x risk)
- Chronic infections in osteoradionecrosis

...and won't reduce wound infections in your patients!

24 hours prophylaxis is plenty for all head and neck surgery, including:

- Oncology surgery, including sarcoma
- Salvage surgery (after chemo/radiation)
- Oral cavity or pharyngeal surgery
- When packs or metalwork are left in

If in doubt, call microbiology on x79515 for:

- Clinical signs of infection after 24 hours (send swab first)
- Meticillin-resistant *Staphylococcus aureus*-positive cases

Bottom line: Give co-amoxiclav on induction, 4-hourly intraoperatively, then at 8 and 16 hours postoperatively.

Figure 4. University College London Hospital antibiotics guidelines update.