

# Surgical antimicrobial prophylaxis

## SUMMARY

Surgical antimicrobial prophylaxis is the most common indication for antimicrobial use in Australian hospitals. However, it is associated with high rates of inappropriate use.

Effective use of antimicrobials to prevent infection is essential to reduce risks associated with surgical procedures. Efforts need to be made to maximise the quality of surgical antimicrobial prophylaxis prescribing.

Procedural prophylaxis (before or during surgery) is not indicated for all surgeries, especially minor procedures. Post-procedural prophylaxis, including the use of topical antimicrobials, is rarely indicated yet frequently prescribed.

The Therapeutic Guidelines: Antibiotic is a key reference for all Australian prescribers.

GPs can have a significant role in optimising surgical antimicrobial prophylaxis and reducing the burden of inappropriate antimicrobial use.

## Introduction

Surgical antimicrobial prophylaxis refers to the use of antibiotics for the prevention of surgical site infections,<sup>1</sup> and does not include preoperative decolonisation or treatment of established infections. It is the most common indication for antimicrobial use in Australian hospitals. However, 40% of prescriptions were found to be inappropriate in the 2015 National Antimicrobial Prescribing Survey, which analysed 22 021 prescriptions from 281 hospitals.<sup>2</sup> Inappropriate use, such as extended duration of surgical prophylaxis (e.g. 5 days of cefalexin at discharge), contributes to the overall burden of antibiotic use in the community and exposes patients to adverse reactions and *Clostridium difficile* infections.

Optimal prescribing in surgical prophylaxis is ideally concordant with the Therapeutic Guidelines: Antibiotic<sup>3</sup> or local guidelines (as endorsed by the Antimicrobial Stewardship Clinical Care Standard).<sup>4</sup> Prescribing of prophylaxis occurs in acute and primary care. However, current data on the extent of prescribing in primary care are lacking.

## Antimicrobial stewardship

Antimicrobial stewardship is defined as 'coordinated actions designed to promote and increase the appropriate use of antimicrobials',<sup>2</sup> and is considered an important strategy for the conservation of the effectiveness of antibiotics. Since 2011, it has been one of the compulsory criteria for hospital accreditation.<sup>5</sup> Appropriate surgical antimicrobial prophylaxis prescribing is part of the national Antimicrobial Stewardship Clinical Care Standard, which was released in 2014.<sup>4</sup> This standard was developed for hospital and

general practice prescribers and patients. Monitoring antimicrobial use and resistance is a requirement of the National Safety and Quality Health Service Standards.<sup>6</sup>

Significant improvement in prescribing practices (potentially attributable to antimicrobial stewardship programs) in hospitals has been observed by auditing tools such as the National Antimicrobial Prescribing Survey.<sup>2</sup> Despite identifying surgical antimicrobial prophylaxis prescriptions as a key area of concern, the 2015 Survey found a decline in the proportion of surgical prophylaxis prescriptions extending greater than 24 hours.<sup>2</sup> Further improvements are still required to meet the best-practice target of less than 5%.<sup>2</sup>

The 2016 Surgical National Antimicrobial Prescribing Survey solely focuses on surgical prophylaxis prescribing.<sup>7</sup> Its results highlight ongoing concerns regarding inappropriate procedural and post-procedural prescribing (43.4% and 46.5% respectively) in Australian hospitals. Procedural prophylaxis was defined as any antimicrobial prescribed immediately before or during the surgery, while post-procedural prescribing refers to antimicrobials given after the procedure. Where guidelines were available, 41% of procedural and 62% of post-procedural prophylaxis was non-concordant with guidelines (see Table).<sup>7</sup>

## Appropriate surgical antimicrobial prophylaxis

The key elements of appropriate surgical antimicrobial prophylaxis prescribing include the correct indication, antimicrobial, drug dose, route, timing of administration and duration.

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Table 2016 Surgical National Antimicrobial Prescribing Survey results

Key assessments	Procedural prophylaxis*	Post-procedural prophylaxis
Overall inappropriateness of prescribed antimicrobials	43.4% <sup>†</sup> (1384/3189)	46.5% <sup>‡</sup> (1032/2218)
Prescribed antimicrobials non-compliant with guidelines (where guidelines were available)	41% <sup>†</sup> (1211/2954)	62% <sup>‡</sup> (894/1442)
Surgical episodes where antimicrobial prophylaxis was prescribed but not indicated	10.6% (281/2641)	40.3% (503/1248)

\* antimicrobials prescribed immediately before or during the surgical procedure

<sup>†</sup> procedural antimicrobials measured in doses

<sup>‡</sup> post-procedural antimicrobials measured in prescriptions (or courses)

Source: Reference 7

### Right indication

All surgical procedures carry a risk of infection. However, the benefit of prescribing prophylaxis must be balanced against the potential risks of antimicrobial use, including allergic reactions, antibiotic-associated *C. difficile* and antibiotic resistance.

The 2016 Surgical National Antimicrobial Prescribing Survey found procedural antimicrobial prophylaxis was prescribed but not indicated in 10% of surgical procedures, and post-procedural prophylaxis was prescribed but not indicated in 40% of procedures (see Table).<sup>7</sup>

Prophylaxis is not indicated for clean non-prosthetic-associated procedures as defined by international guidelines.<sup>3,8,9</sup> It is more likely to be indicated for procedures where:

- the incidence of surgical site infections tends to be high, for example, colorectal surgery
- the consequences of infection are significant, for example, surgery with implanted material such as arthroplasty and cardiac valve surgery.

Overall, there is insufficient evidence to support surgical prophylaxis for minor procedures, and prophylaxis in general practice is usually not warranted.<sup>3,9-11</sup> If a patient has an associated infection (e.g. ingrown toenail, or abscess with cellulitis), an appropriate course of antibiotics should be given but this would not be considered prophylaxis. Key practice points for prescribing appropriate surgical antimicrobial prophylaxis in primary care are listed in the Box.

For dental procedures, guidelines recommend that antimicrobial prophylaxis may be appropriate for surgery in immunocompromised patients, and for surgical removal of a bone-impacted tooth or periapical surgery in a patient with a history of recurrent infections.<sup>3,8,12</sup>

### Box Best-practice surgical antimicrobial prophylaxis in general practice

Do not prescribe surgical antimicrobial prophylaxis without an appropriate indication

Avoid topical antimicrobials for surgical procedures

Use the eTG for specific information regarding optimal drug, dose, route and timing<sup>3</sup>

Query long-term use of post-procedural antibiotics with the initial prescriber or surgical team

Avoid prescribing ongoing supply of topical and oral antimicrobials without a clear indication from the initial prescriber

Monitor for surgical complications such as superficial, deep and organ space infections, and discuss with the surgeon or treating hospital

The presence of catheters or surgical drains is not an appropriate indication for prolonging surgical prophylaxis.<sup>13</sup> This use is not supported by current evidence and may increase the risk of adverse events associated with antimicrobial use.<sup>8</sup>

### Right antimicrobial

The choice of antimicrobial is ultimately influenced by the surgical procedure and associated risk factors. It should provide coverage of the expected microbiological flora at the incision site.<sup>14</sup> This is further influenced by multiple patient-specific risk factors including:

- pre-existing infection
- recent antimicrobial use
- known colonisation with a resistant organism
- prolonged hospitalisation
- prostheses
- weight<sup>15-17</sup>

- renal function
- allergy status
- comorbidities
- immunosuppression.

For the majority of procedures, a first-generation cephalosporin, such as cefazolin, remains the preferred antimicrobial for prophylaxis.<sup>3,14,18</sup> Uptake of this recommendation was shown across current Australian practice in the 2016 Surgical National Antimicrobial Prescribing Survey, with cefazolin being the most commonly prescribed antimicrobial for procedural (69%) and post-procedural prophylaxis (57%). However, 50% of the post-procedural cefazolin prescribing was deemed inappropriate.<sup>7</sup>

### Right dose

When indicated, a single defined dose of antibiotic(s), for example, 2 g intravenous cefazolin, is sufficient for most procedures.<sup>3,14</sup> This dose may be influenced by patient-related risk factors such as age, renal function and weight.<sup>15-17</sup>

### Right route of administration

Parenteral administration (intravenous or intramuscular) is the preferred route for surgical antimicrobial prophylaxis. However, there are exceptions, including intracameral use for ophthalmic procedures,<sup>3,19</sup> oral antibiotics for transurethral resections of the prostate<sup>3</sup> and surgical terminations of pregnancy,<sup>3,20</sup> and oral amoxicillin before certain dental procedures for endocarditis prophylaxis.<sup>3,12,21</sup>

Within the acute setting, the 2016 Surgical National Antimicrobial Prescribing Survey identified intravenous administration as the most common route for procedural (94.2%) and post-procedural antimicrobials (64.5%). Oral administration accounted for 20.4% of post-procedural antimicrobials, however only 18.4% of oral administrations were deemed appropriate.<sup>7</sup>

### Topical prophylaxis

Overall, there are conflicting data regarding the benefits of topical antimicrobial prophylaxis,<sup>22</sup> and it is currently not indicated for most wounds, especially those resulting from clean procedures. The most recently updated Centers for Disease Control and Prevention guidelines for the prevention of surgical site infections also advise against the application of topical prophylaxis.<sup>8</sup> Despite insufficient evidence, antibiotic ointments and creams are frequently used for topical prophylaxis.<sup>23</sup>

Antimicrobial prophylaxis should not be used as a stopgap for inadequate infection prevention measures. Similarly, topical prophylaxis should not be a substitute for good surgical closure technique and

dressing management, particularly in cases where wounds are hard to seal and dress.

The most recent Cochrane review proposes that topical prophylaxis 'probably' prevents surgical site infections when compared to antiseptics or no topical antibiotic use.<sup>24</sup> However, when comparing topical antibiotics to no topical antibiotic use, the number needed to treat for one additional beneficial outcome was 50. It is important to note that this Cochrane review of trials from 1967 to 2014 found a considerably high risk of bias. The authors could not draw conclusions regarding the influence of topical antibiotics on antibiotic resistance and wound healing.

An earlier review on topical prophylaxis in dermatological procedures concluded that there was no significant difference between topical antimicrobials and petrolatum or paraffin for postsurgical wound infections.<sup>25</sup> An Australian study found that topical chloramphenicol for high-risk suture wounds produced only a moderate absolute reduction in infection rate that was statistically but not clinically significant.<sup>26</sup> An earlier Australian randomised controlled trial including 1801 surgical wounds found no significant benefit from mupirocin or paraffin ointments before occlusive dressings when compared to no ointment use.<sup>27</sup>

### Antimicrobial resistance

High use of topical prophylaxis may increase the risk of antimicrobial resistance. A New Zealand study has correlated increasing use of topical fusidic acid with a rapid clonal expansion of fusidic acid-resistant *Staphylococcus aureus*.<sup>28</sup>

Topical mupirocin is commonly indicated for decolonisation of methicillin-susceptible *S. aureus* (MSSA) and methicillin-resistant *S. aureus* (MRSA). Increased use has been associated with 'emergence of resistance through enhanced selective pressure and cross-transmission'.<sup>29</sup> A Korean drug utilisation review found an increase in mupirocin consumption correlated with increases of low- and high-level mupirocin resistance in MRSA infections.<sup>30</sup>

Unrestricted use of mupirocin, in particular for wounds and pressure sores, is strongly associated with increased resistance.<sup>29</sup> Fortunately, in Australia, mupirocin is a Schedule 4 prescription-only medicine so both GPs and hospital prescribers have a significant role in reducing its inappropriate use.

### Right timing of administration

Appropriate surgical prophylaxis achieves antimicrobial serum and tissue concentrations that exceed the minimum inhibitory concentration for the most probable organisms at the surgical site during the procedure.<sup>14</sup> Appropriate timing of antimicrobial administration is crucial to prevent effective surgical site infection.

Incorrect timing of prophylaxis before or during a procedure was the most common factor in inappropriate prescribing in the 2016 Surgical National Antimicrobial Prescribing Survey (45.7%).<sup>7</sup>

Most guidelines, including Therapeutic Guidelines: Antibiotic, recommend that preoperative intravenous antibiotics be given within 60 minutes of incision.<sup>3,8,14,31-34</sup> More recently, the World Health Organization recommended administration within 120 minutes of incision.<sup>35</sup> For caesarean sections, evidence supports antimicrobial prophylaxis before cord clamping rather than afterwards.<sup>36,37</sup>

### Right duration

A single preoperative dose is adequate for the majority of procedures. Post-procedural doses of intravenous antibiotics (up to 24 hours) are only required in defined circumstances, such as some cardiac and vascular surgeries, and lower limb amputation.<sup>38-40</sup>

The 2016 Surgical National Antimicrobial Prescribing Survey found that incorrect duration was the most common factor in inappropriate post-procedural antimicrobial prescribing (73.7%).<sup>7</sup> Prophylaxis should not extend beyond 24 hours, regardless of the surgical procedure. Intravenous and oral antibiotic prophylaxis offer no benefit beyond this period.<sup>3</sup>

Post-procedural antimicrobials may be initiated in the acute setting but can be reviewed and re-assessed during follow-up with the GP. It is essential that the surgical team clearly communicates with the GP about post-procedural antimicrobial use (usually in the discharge summary).

A recent retrospective cohort study included 1488 patients who received at least 24 hours of parenteral or oral antibiotic therapy. The study identified 20% (n=298) of these patients experienced at least one antibiotic-associated adverse event, and 20% (n=56) of those adverse events were associated with non-clinically indicated antibiotic regimens.<sup>41</sup> The authors stated for every 10 additional days of antibiotic therapy, there was a 3% increased risk of adverse events.<sup>41</sup>

### Conclusion

It is important that all prescribers conserve the usefulness of available antibiotics through the practice of appropriate antimicrobial prescribing. GPs and surgeons play a role in reducing inappropriate surgical antimicrobial prophylaxis by only prescribing prophylaxis when indicated.

Further research into surgical antimicrobial prophylaxis prescribing is warranted to tailor future antimicrobial stewardship interventions for these targeted areas and to ensure that there are appropriate guidelines tailored for general practice that are available at the point of care. ◀

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