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### Prevention of surgical site infections

Wolfhagen, N.

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# **General introduction and outline of thesis**

# GENERAL INTRODUCTION AND OUTLINE OF THESIS

## **Surgical site infections**

All surgical procedures are associated with risks. There are general and surgical site related complications. General complications include healthcare associated infections such as urinary tract infections, hospital acquired pneumonia but also non-infectious complications such as thrombosis. Surgical site related complications include excessive blood loss, nerve injury and wound complications including surgical site infections, seroma, hematoma, wound dehiscence, or hernia.

Common postoperative complications are surgical site infections [SSI].<sup>1</sup> The Centers for Disease Control and Prevention [CDC] defines a surgical site infection as an infection at the incisional, space or organ site [e.g. intra-abdominal] based on clinical signs such as pain, tenderness, localized swelling, redness, fever or purulent drainage and possibly accompanied with microbiology testing, histopathologic exam or imaging.<sup>2</sup>

The incidence of SSI overall is estimated at 2%, but there is great variability between different surgical procedures.<sup>3</sup> For laparoscopic cholecystectomies for example, the incidence is estimated on 1.0% to 2.5%, whilst reported incidences vary from 5% to as high as 25% for colorectal surgery<sup>3-6</sup>. SSI cause increased morbidity, prolonged hospital stay, increased readmission rate and mortality (1, 3-5, 9). Consequently, SSI are associated with increased health care costs. In the Netherlands attributable cost of SSI after a colectomy is estimated at €14,084 corresponding to annual cost of €29.0 million.<sup>7</sup> In the US, the estimated annual economic burden is around 3.22 to 10.0 billion dollars.<sup>8</sup>

## **Prevention of surgical site infections**

Considering the large impact on both patients and society, a lot of research has been done regarding SSI pathogenesis and its prevention. Many risk factors have been identified. Some are patient related such as diabetes mellitus, chronic obstructive pulmonary disorder, body mass index and smoking but others are procedure specific, and thereby within our sphere of influence, such as timing of surgical antibiotic prophylaxis.<sup>9,12 13,14</sup>

Around 50% of SSI are preventable.<sup>15</sup> Over the last years multiple international guidelines have been made to help prevent SSI.<sup>16-18</sup> Institutes such as the World Health Organisation [WHO] in 2016, CDC in 2017 and the National Institute for Health and Care Excellence [NICE] in 2019, have all published guidelines. These three guidelines provide recommendations on individual interventions for the prevention of SSI in the preoperative, intraoperative, and postoperative setting. On many topics the guidelines include recommendations to apply interventions in case of a benefit or recommend refraining from performing interventions without any benefit. In few cases, there is limited evidence and therefore the guidelines do not provide a recommendation. The WHO, CDC and NICE guidelines performed systematic reviews for topics they discuss. Yet, besides substantial consistencies among the guidelines, conflicting results between systematic

reviews or interpretation of results remain, for example on topics as preoperative skin antiseptics and bowel preparation.

### **Care bundles**

Prevention of infectious complications is also strived for by medical fields other than surgery. Successful initiatives include the use of a care bundle. A care bundle, as defined by the Institute for Healthcare Improvement [IHI] concerns a set of three to five evidence-based practices that improve clinical outcomes when performed together.<sup>19</sup> In the intensive care unit [ICU] the incidences of central line-associated blood stream infections [CLABSI]<sup>20</sup> and ventilator assisted pneumonia [VAP]<sup>21</sup> were reduced with more than 60 percent after implementation of a care bundle. Also the outcomes of sepsis improved greatly.<sup>22</sup> At the medical wards we managed to reduce central venous catheter related bloodstream infections.<sup>23</sup> Thus far though, few large randomized trials have been performed that investigate the use of care following the principles of the IHI in order to reduce surgical site infections.

### **Dutch clinical care**

In the Netherlands there is no Dutch guideline for the prevention of SSI. However in 2008, the Post-Operatieve Wondinfectie [POWI] bundle consisting of surgical antibiotic prophylaxis, no hair removal unless necessary, normothermia and hygiene discipline measured through the number of door movements was introduced.<sup>24</sup> The POWI bundle is relatively limited in comparison to international guidelines as many aspects of perioperative care are not standardized. Perioperative care can therefore be optimized beyond current care in the Netherlands.

## OUTLINE OF THIS THESIS

This thesis reports on (bundled) interventions aimed at reducing the incidence of surgical site infections [SSI] and improving current clinical care beyond present standards.

**Part I** concerns the development of an enhanced perioperative care and health protection program (EPO<sub>2</sub>CH) and the prospective evaluation of its effect in the EPO<sub>2</sub>CH randomized controlled trial. **Chapter 1** reports the results of a systematic review on trials that investigated a care bundle to reduce SSI and aims to investigate characteristics of care bundles that contribute to potential efficacy. **Chapter 2** describes the design of the protocol of the EPO<sub>2</sub>CH bundle and the EPO<sub>2</sub>CH-trial, a pragmatic superiority randomized controlled trial. The EPO<sub>2</sub>CH bundle consists of hyperoxygenation, normothermia, normoglycemia, normovolemia and wound irrigation. **Chapter 3** describes the statistical analyses plan, designed to evaluate the effect of the EPO<sub>2</sub>CH trial. **Chapter 4** presents the results of the EPO<sub>2</sub>CH-trial by comparing the incidence of SSI in the group that was treated with the EPO<sub>2</sub>CH bundle added to standard care versus the group that received only standard care.

**Part II** addresses other potential perioperative measures to prevent SSI. **Chapter 5** is an overview of current literature on the effect of preoperative oral antibiotics with and without mechanical bowel preparation on SSI incidence in colorectal surgery. **Chapter 6** presents a network meta-analysis on different antiseptic solutions for preoperative skin preparation. **Chapter 7** assesses the effect of intra-operative redosing of antibiotic prophylaxes on the incidence of SSI. **Chapter 8** concerns the protocol for an individual participant meta-analyses (IPDMA) on the effect of triclosan coated sutures on abdominal wall dehiscence. **Chapter 9** presents the results of this IPDMA. **Chapter 10** is an opinionating narrative on the glove and instrument change before abdominal closure.

Finally, the results and conclusions of this thesis are summarized in English and Dutch. **The future perspectives section** provides an overall discussion of our efforts to improve the prevention of SSI beyond present standards, and where we stand right now.

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