# Surgical site infections of orthopaedic implants

## Chapter IX

## Valorization

### Impact paragraph

Over the last 7 years, the LROI (national register for joint arthroplasty in the Netherlands) witnessed a growth of total hip joint replacements (THP) by 1000 cases/year (from 23,000 to 30,000) and by 1200 cases/year for total knee arthroplasty (TKP) procedures (from 20,500 to 29,000) (LROI 2018).
Also the number of patients undergoing spinal fusion has increased tremendously in the last decades with more invasive, complex procedures, in younger but foremost older patients and more revision procedures.(1–4)

Because orthopaedic procedures such as total joint replacements and instrumented spinal fusion have shown good results, limiting pain and improving functioning and quality of life, a further rise of performance of these procedures in the coming decades in Western society is expected, (LROI 2018).(2,3)

Unfortunately, the use of orthopaedic implants bears an inherent risk for bacterial infection. In literature the incidence of surgical site infection (SSI) after spinal surgery ranges from 2 to 12%, depending on diagnosis, surgical approach, the use of spinal instrumentation, and the complexity of the procedure.(5–7) The incidence of prosthetic joint infection ranges between 1-2% in literature and appears to be increasing just as the incidence of SSI after spinal surgery.(8)

Postoperative infections after instrumented orthopaedic surgery may have devastating consequences such as spinal non-union, osteomyelitis, implant loosening, sepsis, multi organ dysfunction and even death. Hospital stay may increase with 5.8 to 17 extra days and patients with orthopaedic surgical site infections (SSI) also utilize more healthcare resources, including outpatient and emergency department visits, radiology, and home health aides. Consequently, the financial burden is more than twice as high for cases with a SSI compared to patients without SSI.(9,10)
The costs of revision procedures caused by infection are expected to further increase in the near future and treatment is becoming more complex because of more complicated infections by the emergence of new resistant bacterial strains as well as infections with rare organisms.(11–13)

When compared with patients with uncomplicated joint arthroplasty, patients with infection scored significantly lower in satisfaction scales. (14) Also patients with SSI after spine surgery have substantially greater physical limitations and a distinct decrease in quality of life.(9,15)

In this thesis we described and analysed an infection treatment algorithm using gentamycin loaded beads for local antibiotic treatment for hip and knee prosthesis and for infections after instrumented spine surgery. The treatment protocols showed high success rates and the additional use of gentamicin impregnated beads, which lead to a very high local concentration of antibiotics could especially be useful in cases when instrumentation cannot be removed or in case of infection with highly resistant microorganisms. In this way, the use of local antibiotic delivery may help reduce the devastating economic and social consequences and associated outcomes of an SSI after surgery.
In future research, the use of resorbable antibiotic impregnated beads should be studied in order to avoid the extra operation of removal of the beads. Also the antibiotic release of other antibiotics than gentamicin and

vancomycin should be studied knowing that there is an increase of difficult to treat microorganisms with more antibiotic resistant patterns in orthopedic infections. The method of determining antibiotic release patterns of impregnated beads described in this thesis has been proven reliable and could well be used to analyze the release kinematics of other local antibiotics as well as in other material properties of the beads.
By the introduction of new technics and products like antibacterial or antibiofilm coatings and biofilm deconstructive wound lavage our infection treatment can be even more successful in future and decrease financial and clinical consequences of orthopedic infections.(16–18)

Apart from improving treatment for surgical site infections (SSIs) of orthopedic implants, an even better approach would be if we could prevent an SSI from happening. For this purpose, we externally validated an existing prediction model and developed and internally validated a new prediction model, specifically for our cohort of patients with instrumented spine surgery. The nomogram can already be downloaded for free: https://www.evidencio.com/validations/show/330
After an external validation of this prediction model, its performance can be improved and further implemented for widespread use in clinical practice in preoperative setting, where patients can fill in the model that results in a risk of infection. Together with the physician it is possible to identify patients at high risk of SSI and with shared decision making possibly prevent devastating consequences and associated outcomes of an SSI after surgery.
After implementation of such an internally and externally validated model, patients at high risk for infection after surgery can be discussed to prevent an infection.
By the analysis of 'big orthopaedic patient databases' using machine learning techniques, in future prediction models can be further improved to aid in decision making for orthopaedic treatment to an individual patient.

In contrast to infection populations there are already large populations of primary orthopaedic procedures useful for predictive models for outcome and complications.
At present, few prediction models have been developed, but most of these models are still inadequate to be used in daily practice for decision making by orthopaedic surgeons.(19)

In medical oncology and gynaecology, prediction models are widely used to analyse the survival per individual patient for a specific cancer or complications around childbirth.(20,21)

Such specific information for consultation of the individual patient on success or risk of complications after a joint prosthesis or after other orthopaedic procedures is not yet available in orthopaedics, despite the extensive data of these procedures. However, considering the large populations of these joint or spinal procedures, big data analysis, and with the recent introduction of digital health applications it should be possible to collect multiple data from patients a long time before, during and after these orthopaedic procedures. With these big data analyses and with the use of artificial intelligence it should be feasible to develop better prediction models that make individualized diagnostic or prognostic risk predictions for standard orthopaedic interventions.(22)
These prediction models will allow us in the near future to individualize treatment and after-treatment with the goal to optimize success of surgery, or other treatment, with the prevention of complications and dissatisfied outcome. By optimizing orthopaedic treatment also quality of life of individual patients will increase and costs can be reduced.

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