Ventilator-associated pneumonia related to surveillance cultures and bronchoalveolar lavage

Citation for published version (APA):

Document status and date:
Published: 01/01/2016

Document Version:
Publisher's PDF, also known as Version of record

Please check the document version of this publication:
- A submitted manuscript is the version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher’s website.
- The final author version and the galley proof are versions of the publication after peer review.
- The final published version features the final layout of the paper including the volume, issue and page numbers.

Link to publication

General rights
Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal.

If the publication is distributed under the terms of Article 25fa of the Dutch Copyright Act, indicated by the “Taverne” license above, please follow below link for the End User Agreement:
www.umlib.nl/taverne-license

Take down policy
If you believe that this document breaches copyright please contact us at:
repository@maastrichtuniversity.nl
providing details and we will investigate your claim.

Download date: 04 Aug. 2019
Valorisation addendum

Global mapping surveillance cultures results to beat multidrug-resistance
Introduction

Whereas addendum means addition, appendix, or supplement, valorisation is a less familiar term. It may be defined as “a process assuring that scientific knowledge can be used in practice. It is the act of making research results appropriate and useful in order to enhance opportunities for others to use them” (Advisory Council for Science and Technology Policy, 2007). As from September 2014, Rector Magnificus prof. dr. L.L.G. Soete obliged all Maastricht University Ph.D. students to include a valorisation addendum in their thesis. The current valorisation addendum explores the possibilities of mapping surveillance cultures results as well as making these results easy accessible for other physicians and microbiologist in order to diminish multidrug-resistance worldwide.

Background

The present thesis explores the role of surveillance cultures and bronchoalveolar lavage fluid analysis in ventilator-associated pneumonia diagnosis and management. As presented in the previous chapters, it reveals many interesting results. Whereas the phenomenon ventilator-associated pneumonia and the diagnostic modality bronchoalveolar lavage are frequently investigated by others, surveillance cultures are a relatively new subject for research. In Chapter 3, it is demonstrated that obtaining surveillance cultures is common practice in the Netherlands and that there are indications that this Dutch policy could be extrapolated to the rest of the developed world. The significance of some surveillance cultures results is not always unambiguous for both intensive care unit (ICU) physicians and consultant medical microbiologist. Yet, this thesis revealed that surveillance cultures results could be helpful for clinicians on a different way than expected. When using surveillance cultures results as demonstrated in Chapter 4, they may provide valuable information on microorganisms prevalence and antibiotic susceptibility in a hospital department or a district over time. In that chapter, a model was created based on all surveillance cultures of endotracheal aspirates that identified potentially pathogenic micro-organisms in two separate years in two different hospitals. This model revealed useful information for local ICU physicians and medical microbiologists regarding the most likely microorganisms to be identified in endotracheal aspirate cultures related to the day after hospital admission. Additionally, their susceptibility to most frequently used antibiotics was included. By expanding the model, it may be helpful for many additional ICU physicians, medical microbiologist, infectious disease doctors, as well as ICU patients worldwide.
The concept

Since the results of endotracheal aspirate cultures of two ICUs already revealed valuable data, it would be very interesting to collect all surveillance cultures results of all ICUs worldwide in the future. A schematic overview of the concept as well as a proposal for its practical implementation is provided in Figure VA 1. Culture results of all endotracheal aspirates obtained in all ICUs may be included. The value of (surveillance) cultures obtained from other locations than endotracheal aspirates is less frequently investigated and are therefore not included. Yet, when more studies are conducted to define their role, culture results of these samples may be included in the future as well. Participating ICUs shall send their surveillance cultures results, which include the names of the microorganisms identified and the susceptibility analyses results, to a general database. This database arranges the results according to at least the following parameters (as provided by the participating ICUs):

- Type and location of the ICU
- Site of the sample
- Date of hospital admission
- Date of sample obtaining

Preferably, the following parameters will also be provided:

- Time to positivity of the sample
- Semiquantitative result
- Antibiotic administered
- Medical history (especially pulmonary diseases, such as chronic obstructive pulmonary disease, bronchiectasis, or cystic fibrosis)
- Readmission or recent stay in a healthcare-associated residence (according to the American Thoracic Society definitions)
- Use of selective digestive tract and/or oropharyngeal decontamination

Eventually, for each type and location of ICU, large numbers of previously identified microorganisms including their susceptibility to frequently used antibiotics are available. With this information, the likelihood of the presence of a specific bacteria in a specific sample type in a patient that is admitted for a specific number of days may be predicted. The general database manager subsequently makes results accessible to the users by an easy to use application (“App”) for both personal computers and smartphones, as well as via the internet. An ICU physician who would like to start antibiotics for a presumed pneumonia in an admitted patient enters the type and location of the hospital and the patient’s number of hospital admission days. The application will subsequently reveal the pathogens that were previously identified in similar patients, including their antibiotic susceptibility. In case results of (surveillance) cultures obtained from other locations than endotracheal aspirates are also included in
the database, the ICU physician may be able to fill out the presumed site of infection in the application as well. Then, the application may be used for presumed infection in the ICU, instead of presumed pneumonia in the ICU. Knowing the most likely pathogens, including their antibiotic susceptibility, will probably lead to more appropriate antibiotic administration in participating ICUs. Since patients receive appropriate antibiotics earlier and more frequently, the overall broad-spectrum antibiotic use will decrease and duration of therapy can be shortened. Whereas long and broad-spectrum antibiotic use is a risk factor for multidrug-resistant (MDR) microorganism development, usage of this application will probably lead to a decline in MDR microorganisms in all participating ICUs. In this form, the concept is innovating, as no other global database regarding surveillance culture results currently exist.

The role of medical microbiologist and/or infectious disease doctors

In the concept herein described, the impression may be given that the role of the medical microbiologist and/or infectious disease doctor will be more limited. Indeed, they may not necessarily be involved anymore in the initial decision to start a specific antibiotic. Yet, quality assurance and improvement can further be achieved by consultation of the medical microbiologist and/or infectious disease doctor on fixed times for optimisation of individual ICU admitted patient’s antibiotic treatment regimes. This could be achieved during (daily) multidisciplinary patient discussions and/or may be driven by medical microbiologists and/or infectious disease doctors in case relevant culture results become available. Apart from the attention to the individual patient, optimisation of the antibiotic stewardship in the ICU and in other hospital departments in general can increasingly be the focus of the medical microbiologist and/or infectious disease doctor.

The practical implementation

As MDR is a global health problem, funds should best be obtained from ministries of health matters from separate countries or politico-economic unions, such as the European Union or multilateral organisations, such as the World Health Organisation. Preferably, a prospective randomized clinical trial should demonstrate that a strategy of antibiotic guidance by ‘surveillance cultures mapping’ leads to more appropriate antibiotic use, less overall antibiotic use, and consequently less MDR development compared to current strategies (antibiotics based on [local] guidelines or on expert opinion).
In order to address an audience as large as possible, the results of this trial need to be published in a high rated peer-reviewed journal, read by a large number of intensivists, infectious disease doctors, and microbiologists. When results are convincing, a general database manager with a solid knowledge of information and communication technology as well as programming, should make the software ready for the enormous upcoming numbers of data. Concurrently, heads of the ICUs worldwide need to be convinced that ‘surveillance culture mapping’ has surplus value for their patients and physicians. In order to create broader support, presentations on conferences and congresses for intensivists, microbiologists, infectious disease doctors, and researchers in the field should be given. Furthermore, advertisements could be placed on frequently used social media, such as Facebook, LinkedIn, and ResearchGate. A Twitter account could spread the current state of database development, the number and nature of participating ICUs, new and interesting findings, and MDR incidences. Collaboration with other ICUs which are known to study the use of surveillance cultures may be valuable and valued to achieve the best possible results. In the Ghent University Hospital in Belgium, research professors P.O. Depuydt and S.I. Blot have done great work to establish the value of surveillance cultures in ventilator-associated pneumonia. Finally, intensivists need to know how to subscribe for the application. They need to be correctly informed about the possibilities and presumed level of accuracy, based on the prospective trial and local characteristics, such as MDR prevalence.

Social and economic relevance

The potential relevance of the described concept is various. First, when administrating more appropriate empirical antibiotic therapy, the total duration of antibiotic therapy per patient is diminished, as an infection is needed to be treated with appropriate antibiotics for a certain number of days. As the duration of antibiotic therapy is associated to the risk of MDR development, the overall MDR rate will be diminished. Second, when the overall incidences of MDR microorganisms decline, the risk of other admitted patients getting colonized or infected with these MDR microorganisms is decreased. Third, the mental condition of patients is negatively affected by precaution measures, such as isolation. When less of these precautions are needed, the overall mental condition of our patients will probably improve. Fourth, for the individual patient, the outcome will be favourable if the probability of being treated with the appropriate antibiotics from day one is increased. Furthermore, when appropriately treated from the beginning, the length of hospital stay and thus the possibilities for (infectious) complications are diminished. Consequently, the concept of surveillance cultures mapping has probably a positive effect on both mortality and morbidity. Fifth and last, one may suppose that the total costs of both antibiotics, precaution
measurements, and hospital stay decline when the antibiotics are administered for a shorter period and there are fewer patients needing contact-isolation. Overall, the positive effects of ‘surveillance cultures mapping’ affect the individual patient, other patients, and total expenditures for health care.

Uncertainties, risks, and costs

The uncertainties are incorporated in the risks of the plan to fail. Following the schematic overview in Figure VA 1, all visualized steps enclose a possibility to fail. Yet, some steps are more likely to fail and therefore, they will be further elaborated upon. Conducting a prosperous prospective randomized trial will be accompanied by a lot of uncertainties: it is both time and costs-consuming, depends on numerous hardworking researchers, cooperating staff in other hospitals, and, of course, its outcome. The participation of other ICUs may be challenging as well for at least two reasons. First, one may not believe in the concept or one may not be able to manage the additional work. Second, an easy-to-use application that advises ICU physicians which antibiotics to prescribe may give microbiologist and/or infectious disease doctors the impression that their expertise is being bypassed. This may influence the willingness of hospitals to participate in both the database and use of the application.

The costs will mainly consist of human resources and information and communication technology resources needed to communicate between the ICUs and making the information available. From this perspective, the database may best be managed from a low-wage country, such as India or Pakistan.

Conclusion

Results of surveillance cultures offer a wealth of information. Collecting the results of these cultures worldwide in one database can make it possible to predict the most like pathogens involved, including their susceptibility. Using this information in routine ICU practice to guide empirical antibiotic treatment, will probably lead to decreased MDR worldwide and will consequently positively affect individual patients, other hospitalized patients, and overall healthcare costs.
Figure VA.1 Concept and practical implementation of global mapping of surveillance culture results. ICT: information and communication technology. ICU: intensive care unit.