

Minimum data set and standards in the context of nosocomial infection surveillance and antimicrobial stewardship

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Abstract. Antimicrobial resistance (AMR), i.e., the ability of microbes such as bacteria, viruses, fungi and parasites to resist the actions of one or more antimicrobial drugs or agents, is a serious global threat. Bacterial antibiotic resistance poses the largest threat to public health. The prevention of antimicrobial infections and their spread relies heavily on infection control management, and requires urgent, coordinated action by many stakeholders. This is especially true for nosocomial infections, also known as healthcare-associated infections (HAIs), i.e., infections that are acquired in healthcare settings. It is known that continuous, systematic collection, analysis and interpretation of data relevant to nosocomial infections and feedback for the use by doctors and nurses can reduce the frequency of these infections. Data from one hospital are more valid and more effective when they are compared with those from other hospitals. In order to avoid false conclusions, comparisons are only possible when identical methods of data collection with fixed diagnostic definitions are used. The automatic aggregation of standardized data using data from electronic medical records (EMRs), lab data, surveillance data and data on antibiotic use would greatly enhance comparison and computerized decision support systems (CDSSs). Once standardized, data can be aggregated from unit to institutional, regional, national and EU level, analysed and fed back to enhance local decision support on antibiotic use and detection of nosocomial infections.

Keywords. Surveillance, Healthcare associated infections, Nosocomial infections, AMR, antimicrobial resistance, antimicrobial stewardship, antibiotic stewardship

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1. Introduction

Among the key findings of the WHO 2014 report on antimicrobial resistance is the following: “There are significant gaps in surveillance, and a lack of standards for methodology, data sharing and coordination.”

The European Centre for Disease Prevention and Control (ECDC) reported that in 2011, antibacterial resistance alone causes at least 25,000 human deaths a year in the EU [1]; the United States Centers for Disease Control and Prevention (CDC) report a similar statistic in 2013 for the U.S., stating that at least 23,000 people died due to antibiotic resistant infections [2]. Apart from the loss of human lives, the economic impact is also considerable; the ECDC estimates an annual economic loss due to healthcare costs and productivity losses in the EU of at least 1.5 billion EUR [1]. The estimates in a CDC report are considerable higher; in 2008, healthcare costs in the US directly attributable to antibiotic resistance were estimated as high as 20 billion dollar, while the cost for production loss were estimated up to 35 billion dollar a year [2] (extrapolated from [3]).

Presently, both the CDC and ECDC have established action plans against the threat of antimicrobial resistance. Both programs call for a holistic approach, i.e. a comprehensive effort involving medicine, agriculture, trade and environmental groups. Common actions to address the antimicrobial threat include the early detection, prevention of antimicrobial infections, their spread, improving AMR prescribing, stewardship, and the accurate tracking of AMR on local, national and international levels, in both humans and animals. This will involve the development of tools and standards and improved collaboration to track drug resistance, measure its health and economic impacts, and design targeted solutions.

To be able to make informed decisions, up-to-date data is needed. The data acquisition is not standardized so far, nor does data exchange for cross-border scenarios exist. Experience from e.g. Sweden shows that a standardized data aggregation can help to a) get an overview of the current situation and b) to give back advice for the professionals on the local level. To implement such a system the data acquisition process from the electronic medical record (EMR), to unit and institutional level and further to the regional, national and European level needs to be standardized. Once this data is aggregated on a European level, it is possible to evaluate measures, follow the diffusion of specific organisms in almost real time. In the future, it may even be possible to implement models, simulate different scenarios, and work more towards prevention of infections.

2. Computerized Decision Support Systems (CDSSs) in the context of nosocomial infections

In the last two decades, several attempts have been made to develop CDSSs to lower the burden of manual HAI surveillance. Among these systems are MONI [4–6] and TREAT [7–9]. MONI consists of a medical data warehouse that is filled with patients’ administrative and raw medical data from different hospital IT systems (KIS, LIS, PDMS) every morning. Processing algorithms (written in the HL7 medical knowledge presentation and processing standard Arden Syntax) evaluate, aggregate, and interpret these data in a stepwise manner until they can be mapped into given HAI definitions. The surveillance definitions used by MONI were derived from those published by the

ECDC, the National Healthcare Safety Network (CDC, Atlanta) and KISS (German National Reference Center for Surveillance of Nosocomial Infections, Berlin).

The TREAT system uses a Causal Probabilistic Network (CPN). This allows for combination of data from different datasets and is also robust to missing data. The system was proofed by a randomized controlled trial encompassing 2326 patients in Israel, Germany and Italy [10] The long-term perspective is automatic (e-)surveillance of HAIs. More information can be found in [11].

In the case where structured data is not available, text mining could be an option. A group at Karolinska University Hospital and the Dept. of Computer and System Sciences (DSV) of Stockholm University have used text mining in combination with data mining of structured data to detect HAI. Machine learning algorithms are used to predict HAIs [12]. A recent study is focused on healthcare-associated urinary tract infections (HA-UTI) [13].

The ECDC is in charge of HAI surveillance on European level, which started with Decision No 2119/98/EC in 1998. The **Council Recommendation of 9 June 2009 on patient safety, incl. the prevention and control of HAIs (2009/C 151/01)** contains a paragraph about the prevention and control of HAIs. The importance of HAI surveillance is supported by scientific evidence. A recent systematic review by Zingg et. al. [14] identified 10 key components and proposed some new indicators for the PPS II protocol. The ECDC has set up the HAI-Net, which is actually a network of different national networks [15]. HAI-Net contains different modules (ICU, SSI, CDI, PPS Hospitals, PPS LTCF (HALT)). Reporting is done via the TESSy system. At the national level there are different solutions in the member states with web-based systems (DE,NL,BE,....., ES,PT,HU,AT), semi-automated (DK, SE), or OCR-based (UK) solutions. ECDC also provides Freeware (HELICSWin.Net) to support HAI-surveillance networks [16].

3. Workshop proposal: A minimum dataset for nosocomial infections

A current challenge is the lack of a standardized data set that can be used for electronic surveillance and for CDSSs as well as reporting and comparison of data on institutional, regional and national level and finally on EU or international level. In the US there is an HL7 standard for the reporting of HAI [17]. The Australian Commission on Safety and Quality in Healthcare has issued a document called: Core Information Components - Structured Microbiology Requests and Reports for Healthcare Associated Infections [18]. In Australia more than 22 hospitals in Queensland use the Multiprac IC solution from Ocean Informatics [19]. Germany has implemented a national nosocomial infections surveillance system (KISS) [20]. While several systems exist in various EU countries, there is a lack of coherence and comparability of data. In this workshop the authors of the above systems and experts meet to discuss a minimum dataset that allows comparison and standardized aggregation of data in the context of HAI surveillance and AMR monitoring.

3.1. Workshop objective and outline

The objective of this workshop is to bring together experts on an international level with key expertise in electronic surveillance of HAI, CDSSs for HAI, data aggregation

for antimicrobial resistance monitoring and standardization to discuss opportunities for creating and standardizing a minimum dataset for HAI surveillance and antimicrobial resistance monitoring on European and international level.

- Introduction and Overview of the topic: Gudrun Mernitz, Thomas Karopka, BioCon Valley GmbH
- Minimum Set for HAI surveillance and antibiotic stewardship, Rikard Lövström, University of Linköping, Sweden
- State of the art of using administrative data to identify nosocomial infections, Michael Behnke, Berlin Charité, Germany
- Fully-automated, knowledge-based surveillance with MONI, Stefan Reich, Medexter Healthcare, Vienna, Austria
- Antimicrobial stewardship with TREAT, Mads Lause Mogensen, TREAT Systems, Aalborg, Denmark
- Archetype definitions in openEHR for infection control, Heather Leslie, Ocean Informatics, Australia

Moderation of the workshop: Thomas Karopka

Expected outcome of the workshop: The minimum output of the workshop will be a report that could be a basis for a publication of a paper about the workshop topic.

3.2. Topics to be discussed and engagement of the audience

In particular two topics will be discussed:

- 1) Minimum data set for electronic surveillance and CDSS for HAI:
e.g. Which data elements should be part of the set? Are there existing standards to serve as baseline?
- 2) Standards for reporting: Use existing standards local/national standards and adapt them or create a new, international standard? Groups, communities, organisations to be involved?

Depending on the number of participants, the audience will split up into round tables to discuss the topics outlined above. The workshop will close with the presentation of the group moderators in a joint closing session.

Time requirements: Due to the complex topic it would be ideal to have at least 3 hours or possibly more.

3.3. Target group of the workshop

The target group of this workshop are health IT professionals and researchers working in (or interested in) the field of infection control especially in the field of electronic surveillance of nosocomial infections, CDSS for HAI, systems in the context of antibiotic stewardship and monitoring of antimicrobial resistance. Members from EFMI and IMIA working groups are very welcome in particular experts in clinical decision support and standardization.

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