



# Automated surveillance system for hospital-acquired urinary tract infections in Denmark

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## SUMMARY

**Background:** The Danish Hospital-Acquired Infections Database (HAIBA) is an automated surveillance system using hospital administrative, microbiological, and antibiotic medication data.

**Aim:** To define and evaluate the case definition for hospital-acquired urinary tract infection (HA-UTI) and to describe surveillance data from 2010 to 2014.

**Methods:** The HA-UTI algorithm defined a laboratory-diagnosed UTI as a urine culture positive for no more than two micro-organisms with at least one at  $\geq 10^4$  cfu/mL, and a probable UTI as a negative urine culture and a relevant diagnosis code or antibiotic treatment. UTI was considered hospital-acquired if a urine sample was collected  $\geq 48$  h after admission and  $< 48$  h post discharge. Incidence of HA-UTI was calculated per 10,000 risk-days. For validation, prevalence was calculated for each day and compared to point prevalence survey (PPS) data.

**Findings:** HAIBA detected a national incidence rate of 42.2 laboratory-diagnosed HA-UTI per 10,000 risk-days with an increasing trend. Compared to PPS the laboratory-diagnosed HA-UTI algorithm had a sensitivity of 50.0% (26/52) and a specificity of 94.2% (1842/1955). There were several reasons for discrepancies between HAIBA and PPS, including laboratory results being unavailable at the time of the survey, the results considered clinically irrelevant by the surveyor due to an indwelling urinary catheter or lack of clinical signs of infection, and UTIs being considered HA-UTI in PPS even though the first sample was taken within 48 h of admission.

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**Conclusion:** The HAIBA algorithm was found to give valid and valuable information and has, among others, the advantages of covering the whole population and allowing continuous standardized monitoring of HA-UTI.

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## Introduction

Hospital-acquired infections (HAIs) constitute a major public health concern. Such infections are associated with increased morbidity, mortality, extended hospital stays and increased financial burden on the healthcare system.<sup>1,2</sup> Urinary tract infections (UTIs) are among the most frequently occurring nosocomial infections in Europe, including Denmark.<sup>3,4</sup> Surveillance of such infections is an important step in reducing their occurrence, providing evidence for the implementation and monitoring of preventive interventions.<sup>5</sup>

In Denmark, a 1979 survey estimated the prevalence of hospital-acquired urinary tract infections (HA-UTIs) at 5.5%. Estimates from 1999 showed a reduction to 2.1%, although the study populations were different.<sup>6</sup> Since 2009, manual point-prevalence surveys (PPSs) have been carried out twice a year, estimating a prevalence for HA-UTI at 1.6–2.5%.<sup>7,8</sup> However, these PPSs are conducted on a voluntary basis and not all clinical departments or hospitals participate. The aim of PPSs is to determine the prevalence of HAI on a given day and the surveys are conducted through manual registration of infection by chart reviews.<sup>9</sup>

PPSs are associated with drawbacks and limitations. They are time-consuming, costly, and difficult to standardize. PPSs are subject to variation in classification between individual reviewers and are difficult to compare between hospitals or countries.<sup>1</sup> Several studies have shown that automated surveillance systems, based on electronically registered data such as patient records, antibiotic consumption documentation, and microbiological data, are more reliable and consistent than PPSs for detecting HAI.<sup>1,10</sup>

The Hospital-Acquired Infections Database (HAIBA) is a newly launched, automated surveillance system in Denmark, which combines continuously updated patient administrative data, microbiological laboratory results, and data on antimicrobial treatment.<sup>11</sup> The overall objective of HAIBA is to detect and monitor HAI continuously for all hospitals and clinical departments in Denmark. HAIBA aims to improve the evidence for reducing the incidence of preventable HAI through motivating and supporting hospital staff in evaluating effectiveness of preventive measures.<sup>11</sup> The system further aims to ensure that monitoring HAI in Denmark can be conducted without requiring time-consuming reporting from clinicians or nurses.

HAIBA became operational in March 2015 for HA-bacteraemia and *Clostridium difficile* infections. Data for HA-UTI were added in October 2015. This study outlines the case definition for HA-UTI and describes the surveillance data from 2010 to 2014. Second, this study compares a subset of the surveillance data with data from two PPSs in order to evaluate how the new surveillance system relates to the traditional method for monitoring HA-UTI.

## Methods

### *Danish healthcare system*

In Denmark, secondary and tertiary healthcare is mostly public. Healthcare-related policymaking and management occurs at the national level as well as in five Danish regions. A study describing dynamics in hospital admissions and outpatient contacts registered in the Danish National Patient Registry (DNPR) described 138 Danish hospitals between 2010 and 2014, of which 54 were public (S. Gubbels *et al.*, unpublished data). It was estimated that these 54 public hospitals accounted for 97.9% of inpatient contacts.

### *Data sources*

Three data sources were linked together using the uniquely defined civil registry number (CPR) allotted to all Danish citizens and permanent residents at birth or immigration. First, patient administrative data were obtained from the DNPR.<sup>12</sup> Admission and discharge dates and diagnosis codes were extracted from DNPR. Coherent courses of admission were established taking into account transfers to other departments and hospitals (S. Gubbels *et al.*, unpublished data). Data on all submitted specimens coded as urine sample with a corresponding laboratory analysis code for cultivation were extracted from the Danish Microbiology Database.<sup>13</sup> For these samples, the following data were retrieved: sample collection date, date of receipt in the laboratory, and results of the laboratory cultivation analysis, i.e. type(s) of micro-organisms isolated and their quantification [numbers of colony-forming units (cfu)/mL]. Finally, data on antibiotic treatment were obtained from regional medicine modules of the Capital Region of Denmark and Region Zealand, which hold data on prescribed and administered antibiotics during hospital admission.

### *Case definition in HAIBA*

The HAIBA case definition for HA-UTI specified criteria for classification as either laboratory-diagnosed or probable.

Laboratory-diagnosed UTI:

- At least one urine culture revealing no more than two micro-organisms, with at least one at  $\geq 10^4$  cfu/mL of urine.

Probable UTI:

- A patient with at least one urine culture submitted to a department of clinical microbiology, but not fulfilling the criteria for laboratory-diagnosed UTI and

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