

*ECCMID 2013 - Berlin*

Infection prevention measures in Europe: what makes sense and is it implemented?

**Evidence and expert opinion for  
infection control measures in  
Europe (SIGHT project)**

Walter Zingg, MD



- 1. Background**
- 2. Objectives**
- 3. Project outline**
- 4. Systematic review**
- 5. Implementation, EU-wide applicability**
- 6. Results**
- 7. Summary**

**1. Background**

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Healthcare-associated infections affect hundreds of millions of patients worldwide each year

In the European Union alone, the annual number of healthcare-associated infections can be estimated at 4,544,100 with approximately 37,000 deaths as a direct consequence, and 16 million extra-days of hospital stay

[www.who.int/gpsc/country\\_work/en](http://www.who.int/gpsc/country_work/en)

Allegranzi. *Lancet* 2011;377:228

[www.ecdc.europa.eu/en/publications](http://www.ecdc.europa.eu/en/publications)

These figures have served as a catalyst for the European Centre for Disease Prevention and Control (ECDC) to issue a call for tender to address key elements of infection control in hospitals

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- **Overall goal:** identify the most effective and generally applicable elements of hospital infection prevention and control programmes to support the broadest possible implementation across Europe
- **1. Objectives:** collect, review and appraise in a systematic manner the best available evidence of effectiveness at local/national level of selected components of programmes
- **2. Objectives:** develop expert guidance on key components, put them into perspective and define structure and process indicators

## **Five dimensions were defined by the ECDC:**

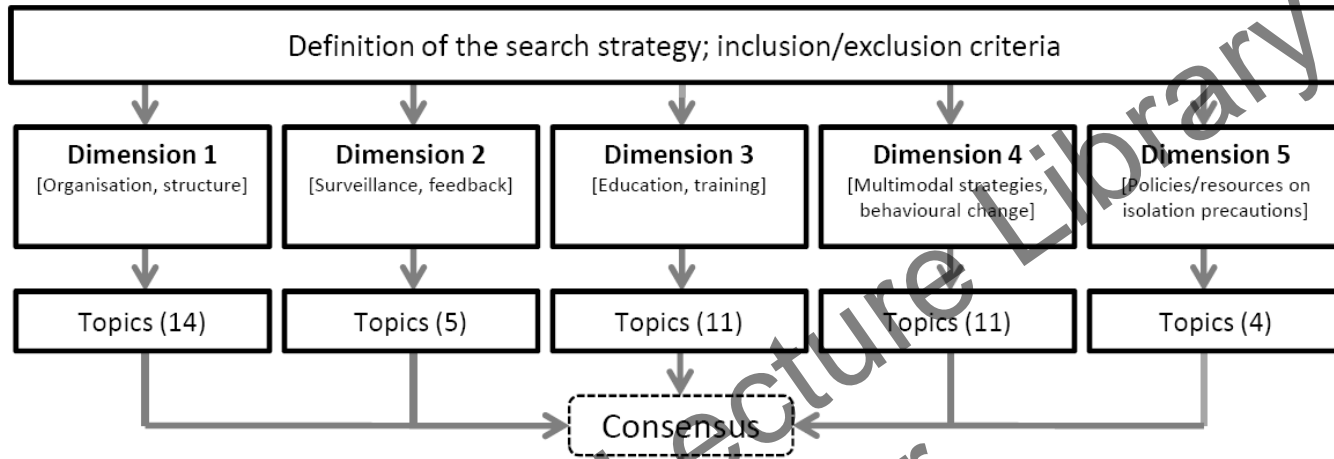
- Organisation and structure
- Surveillance
- Education and training
- Effectiveness of interventions on behavioural change and quality of care
- Policy and resources for isolation precautions



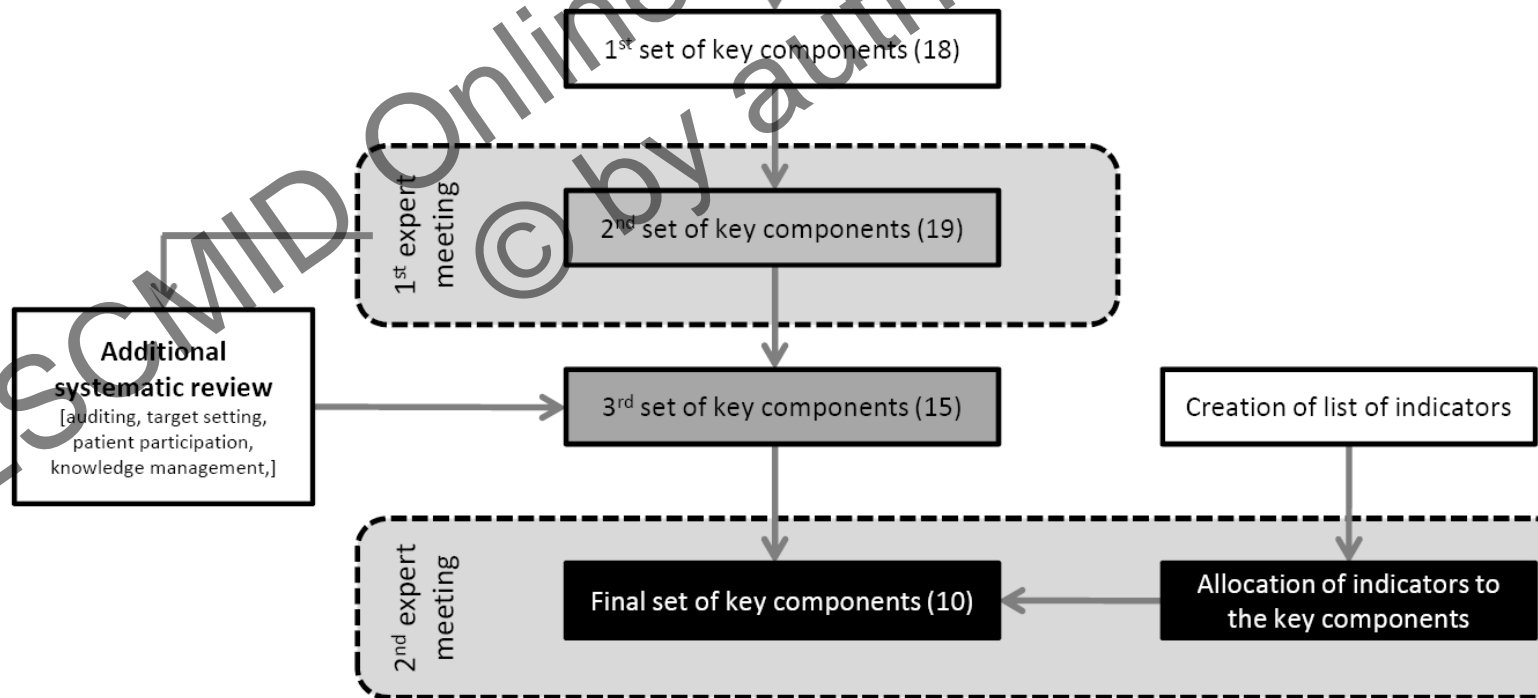
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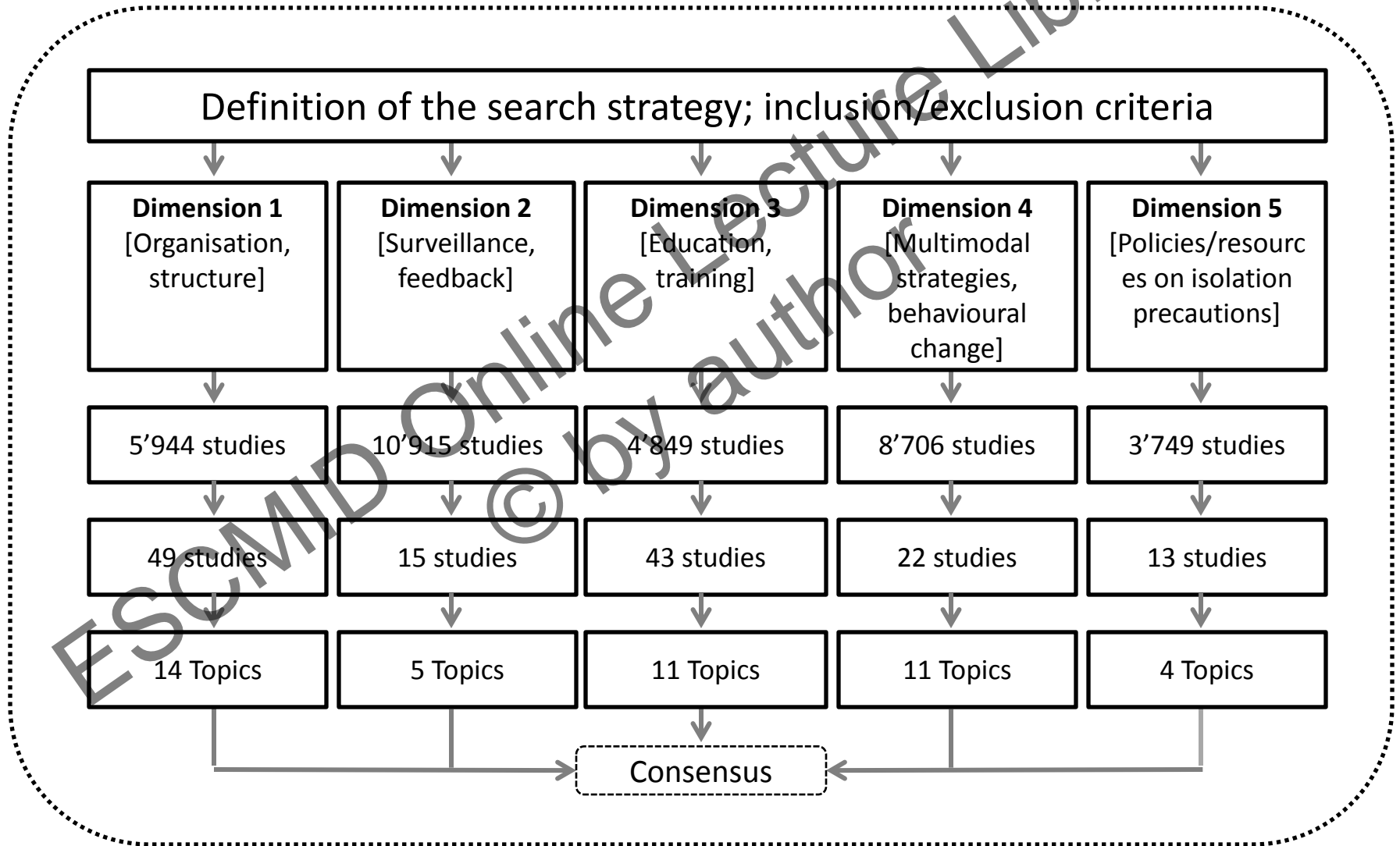
WP1: Systematic review



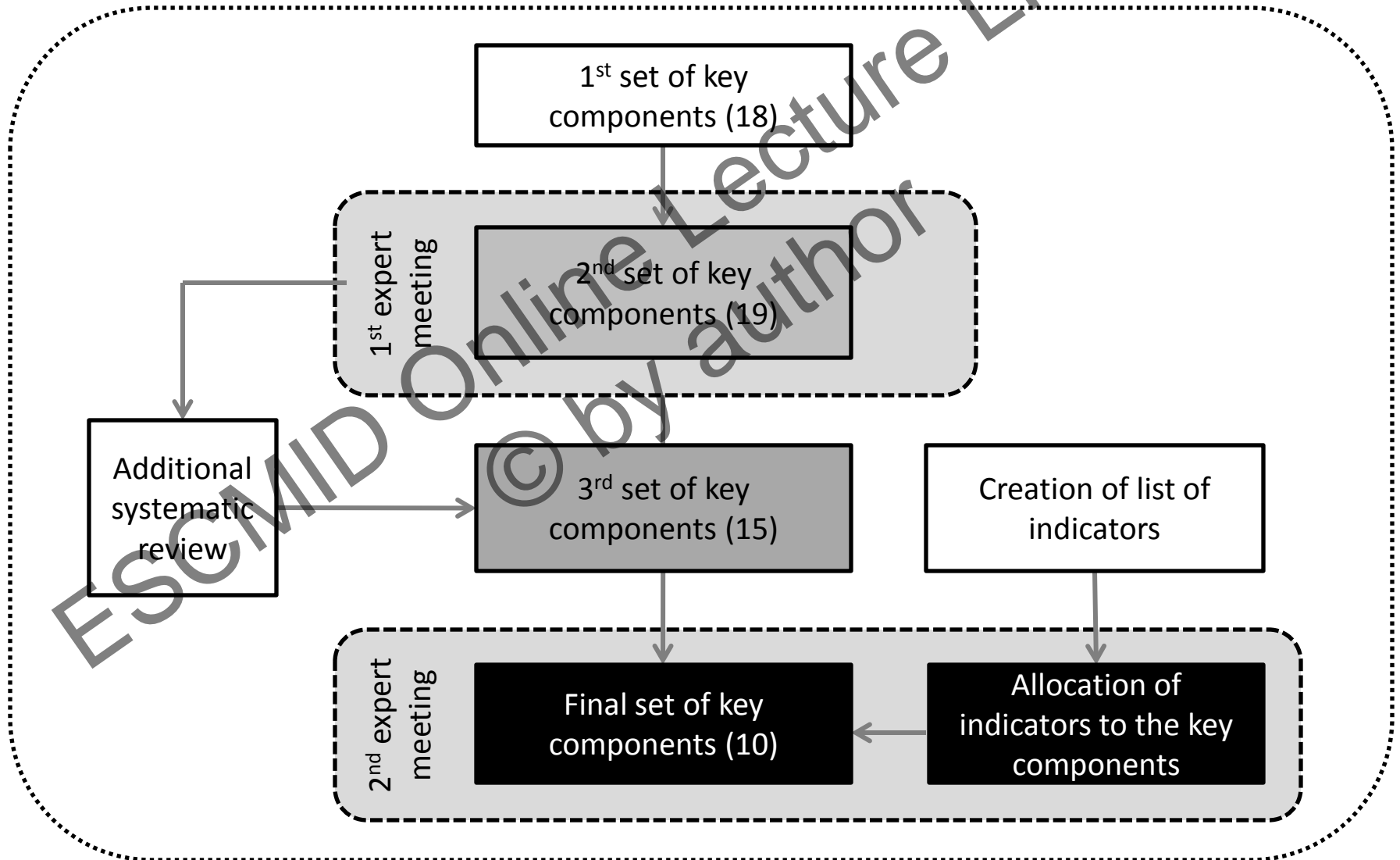
WP2: Definition of key components



# Systematic review



# Definition of the key components



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## **Study settings**

- Any quantitative study using recognised methodology such as randomized controlled trials (RCT), cluster-randomized controlled trials (CRCT), controlled clinical trials (CCT), controlled before-and-after studies (CBA), interrupted-time series (ITS), non-controlled interrupted time-series (NCITS), non-controlled before-and-after (NCBA), and non-controlled cohort study (NCC)
- Any qualitative study using a recognised methodology
- Studies using mixed-methods' approaches

## **Search strategy: Databases, time restrictions, languages**

- MEDLINE, the Cochrane Controlled Trials Register, EMBASE, the Outbreak database, PsychINFO, and HMIC
- 1 January 1996 to 31 December 2010
- In English, Spanish, French, Portuguese, German and Italian

D	Inclusion/exclusion criteria	Outcome measures
1	<ol style="list-style-type: none"> <li>Studies evaluating interventions to change or improve organisation or structure in a health-care setting with regard to the implementation or execution of infection control programmes.</li> <li>Studies evaluating the effectiveness of infection control structures for the improvement of practices and HAI prevention.</li> <li>Studies evaluating the role of hospital management and leadership for the improvement of infection control practices and HAI prevention.</li> <li>Studies evaluating the role of staffing, workload, or work experience with regard to improved adherence with infection control practices.</li> <li>Studies providing information about work processes in the context of patient safety and, specifically, HAI prevention.</li> <li>Studies reporting qualitative research of HCWs' perceptions, attitudes, and beliefs about management, leadership, work climate, and culture in the context of HAI prevention.</li> </ol>	<ol style="list-style-type: none"> <li>Adherence to infection control procedures, such as hand hygiene, device management (including appropriate use, insertion/removal of catheters), perioperative management, and HAI (HAI surveillance).</li> <li>Shifts of nosocomial infections, such as HAI in general, CLABSI/CRBSI, VAP, UTI, and SSI.</li> <li>Shifts in the incidence of MDRO and the rate of <i>Clostridium difficile</i> infection.</li> </ol>
2	<ol style="list-style-type: none"> <li>Studies evaluating the effectiveness of feedback as a surveillance component, and those assessing surveillance as an instrument for outbreak detection and management.</li> <li>Studies evaluating the surveillance of SSI, CLABSI/CRBSI, VAP, and UTI.</li> </ol>	<p>Surveillance of nosocomial infections was defined as "the ongoing systematic collection, analysis, and interpretation of health data essential to the planning, implementation, and evaluation of public health practice, closely integrated with the timely dissemination of these data to those who need to know". Since the successful implementation of surveillance is thought to reduce HAI, the infection rate was defined as a primary outcome. Therefore, studies reporting on improvement in infection prevention and control procedures due to surveillance or feedback were included. Various methods of surveillance, timeliness of data evaluation and feedback, and staff requirements for data collection were also included as outcomes.</p>
3	<ol style="list-style-type: none"> <li>Studies evaluating education or training of HCWs in infection control practices.</li> <li>Studies evaluating the effectiveness of specific training methodologies in HAI prevention, such as ex cathedra teaching, bedside teaching, focus groups, workshops, interactive teaching, knowledge questionnaires, simulation-based learning, written information, and audiovisual learning.</li> <li>Studies evaluating the role of HCWs in infection control training.</li> </ol>	<ol style="list-style-type: none"> <li>Adherence to infection control procedures, such as hand hygiene, device management (including appropriate use, insertion/removal of catheters), perioperative management, and HAI surveillance;</li> <li>Shifts in nosocomial infections, such as HAI in general, CLABSI/CRBSI, VAP, UTI, and SSI.</li> <li>Shifts of MDRO and the rate of <i>C. difficile</i> infection.</li> </ol>
4	<ol style="list-style-type: none"> <li>Studies evaluating interventions intended to: 1) change HCWs' behaviour and/or work practices with regard to infection prevention and control programmes; 2) sustain such changes in behaviour and/or working practices; 3) improve compliance with infection prevention and control procedures/guidelines through behaviour change; 4) improve quality of care through infection control programmes; or 5) remove barriers to adherence to infection control procedures/guidelines.</li> <li>Studies measuring how 1) barriers and/or facilitators to compliance with infection prevention and control procedures/guidelines and/or 2) HCWs' professional roles, perceptions, attitudes, beliefs, culture, views, experience, and behaviour regarding infection control impact on changes in HCWs' behaviour, e.g., improving adherence to infection control procedures/guidelines or quality of care.</li> </ol>	<ol style="list-style-type: none"> <li>Shifts in behaviours and/or alteration of working practices of HCWs in terms of adherence (or enabling adherence) to infection control procedures/guidelines (i.e., quality of care).</li> <li>Effectiveness and/or cost-effectiveness of behavioural change interventions in terms of improved adherence to infection control procedures/guidelines or quality of care.</li> <li>Sustainability and/or long-term persistence of HCWs' compliance with infection control procedures/guidelines.</li> <li>Improvements in quality of care indicators (as defined by the authors of the examined studies) following infection control behavioural change interventions.</li> <li>Impact of changes regarding infection control on professional roles, perceptions, attitudes, beliefs, culture, views, experience, and behaviour of HCWs, and adherence to infection control procedures/guidelines.</li> </ol>
5	<ol style="list-style-type: none"> <li>Studies evaluating resources for standard and transmission-based isolation precautions and the consequences of resource modification.</li> <li>Studies evaluating resources of established policies in relation to their effectiveness in infection prevention.</li> </ol>	<p>Since the implementation of policies for precautions and delivering adequate resources to reduce HAI was considered important, infection rates, colonisation rates, and resistance were considered relevant outcomes. Reporting effectiveness of precautions due to policies or available resources was also included. Studies reporting surrogate markers, such as consumption of alcohol-based handrub, soap, or gloves were also included if such reporting was in the context of resource availability/modification, or policy change.</p>

## Quality assessment



Critical Appraisal Skills Programme (CASP) tool

Effective Practice and Organisation of Care (EPOC) model

Integrated quality Criteria for systematic Reviews Of Multiple Study designs (ICROMS)



# ICROMS: Integrated quality Criteria for Reviews Of Multiple Study designs

- Exclusion of non-controlled before-after, cohort and qualitative studies from systematic reviews can limit the richness of evidence
- A novel quality criteria assessment tool – ICROMS (Integrated quality Criteria for systematic Review of Multiple Study designs) was developed
- Value of including additional methodologies in systematic reviews
- Quality assessment based on *specific* study design → no assessment of quality is made *across* study designs
- Based on the score of the quality assessment, studies were graded between 1 (low quality) and 3 (high quality)

# Decision Matrix – minimum criteria, score and study relevance required for inclusion in review

## Mandatory criteria

- Mandatory quality criteria set for each study type

## Minimum Score

- 34 quality criteria (including mandatory criteria) for each study type
- Each study scored (2 points = yes criterion, 1 point = partial, 0 = no)
- Total score must reach minimum score established for each study type

## Study relevance

- Direct relevance to review objective evaluated

## Inclusion in review

- Outcome matrix also provides means of grading different study types and weighting the scores.

**Study Design\*\***

	Quality Criteria	Specific Criteria*	Study Design**					Prospective Cohort	Qual
			RCT	CBA	CITS	NCITS	NCBA		
1	Clear aims and justification	A. Clear statement of the aims of the research?	✓✓	✓✓	✓✓	✓✓	✓✓	✓✓	✓✓
		B. Rationale for number of pre- and post-intervention points or adequate baseline measurement	x	x	✓	✓✓	✓✓	x	x
		C. Explanation for lack of control group	x	x	x	✓	✓	x	x
		D. Appropriateness of qualitative methodology	x	x	x	x	x	x	✓
		E. Appropriate study design	x	x	x	x	x	x	✓✓
2	Managing bias in sampling or between groups	A. Sequence Generation	✓✓	x	x	x	x	x	x
		B. Allocation Concealment	✓✓	x	x	x	x	x	x
		C. Justification for sample choice	x	x	x	✓✓	✓✓	x	x
		D. Intervention and control group selection designed to protect against systematic difference/selection bias	x	✓✓	x	x	x	x	x
		E. Comparability of groups	x	x	x	x	x	✓✓	x
		F. Sampling and recruitment	x	x	x	x	x	x	x
3	Managing bias in outcome measurements and Blinding	A. Blinding	✓✓	x	x	x	x	x	x
		B. Baseline measurement – protection against selection bias	x	✓✓	x	x	x	x	x
		C. Protection against contamination	x	✓✓	x	x	x	x	x
		D. Protection against secular changes	x	x	✓✓	x	x	x	x
		E. Protection against detection bias: Blinded assessment of primary outcome measures	✓	✓	✓	✓	✓	✓	x
		F. Reliable primary outcome measures	✓	✓	✓	✓	✓	✓	✓
		G. Comparability of outcomes	x	x	x	x	x	✓✓	x
4	Managing bias in follow-up	A. Follow-up of professionals (protection against exclusion bias)	✓	x	x	x	x	x	x
		B. Follow-up of patients or episodes of care	✓	x	x	x	x	x	x
		C. Incomplete outcome data addressed	✓	✓	✓	✓	✓	✓	✓
5	Managing bias in other study aspects	A. Protection against detection bias: Intervention unlikely to affect data collection	x	x	✓	✓	✓	x	x
		B. Protection against information bias	x	x	x	x	x	✓	x
		C. Data collection appropriate to address research aims	x	x	x	x	x	x	✓
		D. Attempts to mitigate effects of no control	x	x	x	✓✓	✓✓	x	x
6	Analytical rigour	A. Sufficient data points to enable reliable statistical inference	x	x	✓✓	x	x	x	x
		B. Shaping of intervention effect specified	x	x	✓	x	x	x	x
		C. Analysis sufficiently rigorous/free from bias	✓	✓	✓	✓	✓	✓	✓
7	Managing bias in reporting/ ethical considerations	A. Free of selective outcome reporting	✓	✓	✓	✓	✓	✓	✓
		B. Limitations addressed	✓	✓	✓	✓	✓	✓	✓
		C. Conclusions clear and justified	✓	✓	✓	✓	✓	✓	✓
		D. Free of other bias	✓	✓	✓	✓	✓	✓	✓
		E. Ethics issues addressed	✓	✓	✓	✓	✓	✓	✓

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## The expert group

Cross-EU representation

Expertise in infection control, infectious diseases, clinical microbiology, nursing, patient safety, social sciences, health policy, public services management, psychology

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## The expert group

The components of the systematic review were grouped to key components

The key components were checked against:

- Ease of implementation [3 = high, 2 = intermediate, 1 = low]
- Cross-country applicability [3 = high, 2 = intermediate, 1 = low]

## **Ease of implementation**

- Budget/financial constraints
- Work cultural issues
- Work ethics
- Leadership
- Educational background
- Personal experience
- Relative priority of infection control
- Communication
- Hospital-wide applicability

## **Cross-country applicability**

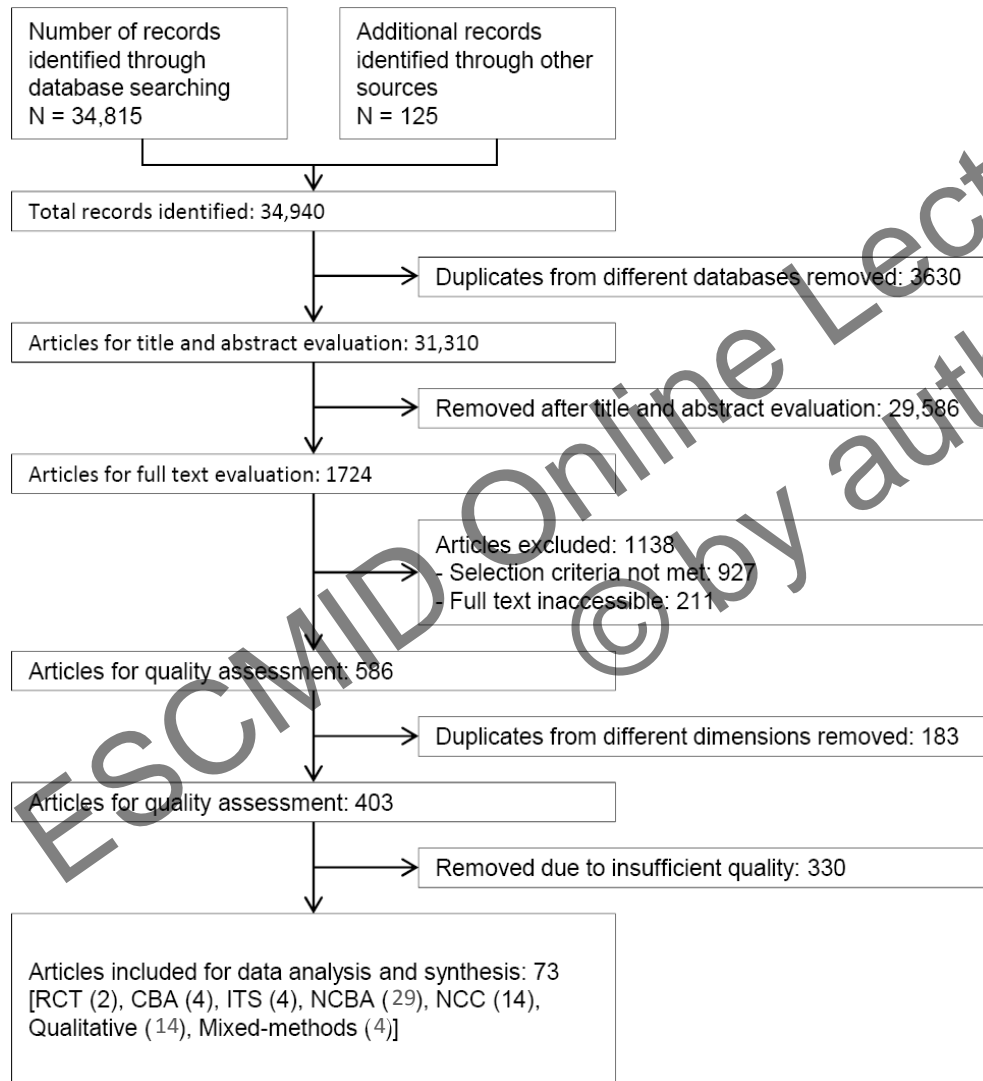
- Financial crisis
- Cultural issues
- Type of healthcare system
- Training opportunities for infection control
- National safety programmes
- Emigration of specially trained ICP

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# Flow diagram of the systematic review



## Key components and indicators

Seventy-three articles were included in the final data analysis

2 RCT , 4 CBA, 4 ITS, 2 CCS, 29 NCBA, 14 NCC, 14 qualitative studies, and 4 mixed methods' studies

Most evidence (67; 91.8%) is from high-income countries – six studies (8.2 %) are from upper-middle-income countries

Thirty-five studies (48%) were conducted in Europe

# Key components and indicators

## Key component

## Indicators

<p>1 An effective infection control programme in an acute care hospital must include at least: one full-time specifically trained IC-nurse <math>\leq</math> 250 beds; a dedicated physician trained infection control; microbiological support; data management support</p>	<ul style="list-style-type: none"> <li>- Detailed infection control activities: number of ongoing surveillance and prevention programmes, outbreaks, number of performed audits</li> <li>- Established infection control: appropriate staffing, IC committee in place, defined goals for IC, identified IC budget, IC on the agenda of the hospital administration, defined outbreak management, vaccination programmes for healthcare workers</li> </ul>
--	---

	1	2	3
Evidence		X	
Ease of implementation			X
EU-wide applicability			X

Haley et al., 1985, USA

# Key components and indicators

## Key component

## Indicators

- |   |   |
|---|---|
| <p>2 To make sure that the ward occupancy does not exceed the capacity for which it is designed and staffed; staffing and workload of frontline healthcare workers must be adapted to acuity of care; and the number of pool/agency nurses and physicians minimized</p> | <ul style="list-style-type: none"> <li>- Average bed occupancy at midnight</li> <li>- Average staffing of frontline workers</li> <li>- Average proportion of pool/agency professionals</li> </ul> |
|---|---|

Cunningham et al., 2006, Northern Ireland  
 Nijssen et al., 2003, The Netherlands  
 Virtanen et al., 2009, Finland  
 Alonso-Echanove et al., 2003, USA  
 Vicca et al., 1999, UK  
 Cunningham et al., 2006, England  
 Mark et al., 2007, USA  
 Howie et al., 2008, UK  
 Blatnik et al., 2006 Slovenia  
 Borg et al., 2008, Malta  
 Andersen et al., 2009, Norway  
 Hugonnet et al., 2007, Switzerland  
 Hugonnet et al., 2007, Switzerland  
 Fridkin et al., 1996, USA  
 Borg, 2003, Malta  
 Petrosillo et al., 2001, Italy  
 Pittet et al., 2004, Switzerland  
 Robert et al., 2000, USA  
 Hugonnet et al., 2007, Switzerland

1 2 3

Evidence

×

Ease of implementation

×

EU-wide applicability

×

# Key components and indicators

Key component

Indicators

3	Sufficient availability of and easy access to material and equipment and optimized ergonomics	<ul style="list-style-type: none"> <li>- Handrub at the point of care</li> <li>- Sinks stocked with soap and single-use towels</li> </ul>
---	---	---

Evidence

Ease of implementation

EU-wide applicability

1 2 3

×

×

×

Mc Laws et al., 2009, Australia  
 Koll et al., 2008, USA  
 Koff et al., 2009, USA  
 Birnbach et al., 2010, USA  
 Mc Laws et al., 2009, Australia  
 Thomas et al., 2009, USA  
 Kho et al., 2008, USA  
 Whitby et al., 2004, Australia  
 Rubinson et al., 2005, USA

# Key components and indicators

Key component

Indicators

4 Use of guidelines in combination with practical education and training

- Guidelines locally adapted
- Number of new staff trained using the local guidelines
- Teaching programmes are based on local guidelines

1 2 3

Evidence

x

Ease of implementation

x

EU-wide applicability

x

Rosenthal et al., 2004, Argentina

Rosenthal et al., 2005, Argentina

Rubinson et al., 2005, USA

Quiros et al., 2007, USA

Larson et al., 2007, USA

# Key components and indicators

Key component

Indicators

5 Education and training involves frontline staff, and is team- and task-oriented

- Audit of education and training programmes  
- Results of knowledge tests and competency assessments

Evidence

Ease of implementation

EU-wide applicability

1 2 3

×

×

×

Marra et al., 2010, Brazil  
Turnberg et al., 2009, USA  
Quiros et al., 2007, USA  
Nicol et al., 2009, Australia  
Sherertz et al., 2000, USA  
Thomas et al., 2005, USA  
Sladek et al., 2008, Australia  
Barsuk et al., 2009, USA  
Zingg et al., 2009, Switzerland

# Key components and indicators

Key component

Indicators

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6	Organizing audits as a standardized (scored) and systematic review of practice with timely feedback	- Number of audits (overall, and stratified by departments/units and topics)
---	---	--

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	1	2	3	
Evidence		x		
Ease of implementation		x		
EU-wide applicability			x	

Moongtui et al., 2000, Thailand  
 Kilbride et al., 2003, USA  
 Cocanour et al., 2006, USA  
 Charrier et al., 2008, Italy

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# Key components and indicators

Key component

Indicators

7	Participating in prospective surveillance and offering active feedback, preferably as part of a network	<ul style="list-style-type: none"> <li>- Participation of (inter-) national surveillance initiatives</li> <li>- Number and type of wards with a surveillance</li> <li>- Regular review of the feedback strategy</li> </ul>
---	---	--

	1	2	3	
Evidence		✗		Gastmeier et al., 2006, Germany Gastmeier et al., 2009, Germany
Ease of implementation		✗		Geubbels et al, 2006, the Netherlands Schwab et al., 2007, Germany Zuschneid et al., 2007, Germany
EU-wide applicability		✗		Rosenthal et al., 2003, Argentina Bärwolff et al., 2006, Germany Gastmeier et al., 2005, Germany Brandt et al., 2006, Germany L'Hériteau et al., 2007, France

# Key components and indicators

## Key component

## Indicators

8	Implementing infection control programmes follow a multimodal strategy including bundles and checklists developed by multidisciplinary teams and taking into account local conditions	<ul style="list-style-type: none"> <li>- Verification that established prevention programmes follow a multimodal strategy</li> <li>- Process indicators: hand hygiene compliance, compliance with medical/care procedures by checklists</li> <li>- Outcome indicators: standardized rates for HAI, infections with MDROs, transmission of MDROs</li> </ul>
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				<p>Peredo et al., 2010, Spain          Thomas et al., 2005, USA          Lederer et al., 2009, USA          Bouadma et al., 2010, France          Creamer, 2000, Ireland          Eggimann et al., 2000, Switzerland          De Palo et al., 2010, USA          Jang et al., 2010, Canada          Pittet et al., 2000, Switzerland          Creedon et al., 2006, Ireland          Mc Laws et al., 2009, Australia          Harris et al., 2000, USA          Marra et al., 2010, Brazil          Mayer et al., 2010, USA          Mc Laws et al., 2009, Australia          Brown et al., 2003, Russia          Koll et al., 2008, USA          Nicol et al., 2009, Australia          Zingg et al., 2009, Switzerland</p>
		1 2 3		
Evidence			x	
Ease of implementation			x	
EU-wide applicability			x	

# Key components and indicators

Key component

Indicators

9 Identifying and engaging champions in the promotion of a multimodal intervention strategy

Interviews with frontline staff and infection control professionals

Evidence

1 2 3

x

Ease of implementation

x

EU-wide applicability

x

Damschroder et al., 2009, USA  
Saint et al., 2009, Italy

# Key components and indicators

Key component

Indicators

10 Positive organizational culture by fostering working relationships and communication across units and staff groups

- Questionnaires about work satisfaction
- Crisis management
- Human resource indicators: absenteeism, healthcare worker turnover

1 2 3

Evidence

x

Ease of implementation

x

EU-wide applicability

x

Elder et al., 2008, USA  
 Saint, ICHE 2010, USA  
 Sinuff et al., 2007, Canada  
 Lines et al., 2006, UK

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It is evident from the wide range of aspects and strategies that key components identified by SIGHT address a **coordinated interplay** between **infrastructure**, hospital **policies**, the presence of **qualified professionals** in adequate number, **administrative support**, and a **positive organisational culture**

Further research and better study reporting is still needed to **improve the quality of available evidence** in infection control

Additional components, such as **knowledge management** and **target-setting**, were identified as gaps in the retrieved evidence

Studies from **non-“high-income” countries** are needed to assess whether identified infection prevention programmes could work in settings with more limited resources and different cultural backgrounds



## Study Team

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