Risk factors and control of hospital acquired infections: a comparison between Wikipedia and scientific literature

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ABSTRACT

BACKGROUND: nowadays Wikipedia is one of the main on-line sources of general information. It contains several items about nosocomial infections and their prevention, together of items on virtually every scientific topic.
This study aims to assess whether Wikipedia can be considered a reliable source for professional updating, concerning Healthcare-associated Infections (HAI).
METHODS: Wikipedia has been searched in order to gather items on HAI. 387 items were found with a search string. The field of research was reduced at those articles (27 items) containing exhaustive information in relation to prevention of HAI. The messages contained in those articles were than compared with the recommendations of a selected guideline (NICE 2003), completed by a literature search, with the aim of testing their reliability and exhaustivity.
RESULTS: 15 Wiki items were found and 51 messages selected. NICE guidelines contained 119 recommendations and 52 more recommendations has been found in a further literature search. 45.1% of Wikipedia's messages were even found in the guidelines. On this percentage, 21.6% completely agreed with the messages of the guidelines, 15.7% partially agreed, 3.9% disagreed and 3.9% showed different level of evidence in different articles. Moreover, 54.9% of Wikipedia's messages were not included in the guidelines and 84.2% of the recommendations contained in the guidelines were not present in Wikipedia.
CONCLUSIONS: Wikipedia should not be considered as a reliable source for professional updating on HAI.

Key words: Internet, Evidence-based Medicine, Recommendations, Wikipedia, Guidelines

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INTRODUCTION

The interest on the access to medical and scientific sources in the 2.0 Web for the professional development or the knowledge sharing is rising [1]. There are several sites using this technology, such as blogs, RSS, podcasts, social networks and, especially, wikies [1].

A wiki is a website whose users can add, modify, or delete its content via a web browser using a simplified language. Wikis are typically created collaboratively, by multiple users (www.en.wikipedia.org/wiki/wiki).

According to a survey of 2006, 73% of Americans owned an Internet access, and 87% of them (which means 128 millions) use it as an instrument for scientific researches; 80% (118 millions) researched something concerned with health care and 64% something related to a specific disease or health problem [2]. A recent survey estimated that 54.5% of Italian citizens (approximately 33 millions) owned an Internet access, and 45.1% use it for health searches [3].

Wikipedia is the most known wiki: 36% of USA web users took information from it in 2007 [2]. According to a survey of Nielsen-Netratings of the same year, in Italy Wikipedia reached the amount of 11 millions of users (which means 56% of the web surfers) [2].

Wikipedia is a free, collaborative, multilingual internet encyclopaedia built using wiki software and that anyone can edit (http://en.wikipedia.org/wiki/Wikipedia). It was founded in 2001 by Jimmy Wales and Larry Sanger and its name comes from the Hawaiian word "wiki" (meaning quick) and Encyclopedia [4].

Wikipedia contains about 16 million of articles in 200 languages, and since its foundation in 2001 it has added 3.7 million articles. The English version has more than 45 000 collaborators and about 1 500 new articles were added every day of October 2005 (http://en.wikipedia.org/wiki/Wikipedia).

Wikipedia has become the 37th most visited website; according to Alexa, a web ranking service survey [4], there is a wide variation on the relative growth of articles: from July 2006 to January 2008 percentages ranged from 38% for religious topics to 213% for natural and scientific items, with a negative percentage of -6% regards technology and applied sciences [5].

Wikipedia has several interesting characteristics, aimed at increasing the quality of the information given and ensure a certain level of protection against misconduct: any change made is displayed immediately, and for any article users can find the state of the development, topic and level of access required to post [4]; articles are classified according with the level of quality and completeness: items with highest degree of development are called "featured articles" ("FA"), and those reporting a very basic description of the topic are classified as "Stub". The quality rating is reported in the page devoted to the discussion of the content (pressing alt-shift-t). FA articles do not need further improvements, unless new information became available, whereas other classes are considered to lack of some important contents [5].

Wikipedia articles must follow several general policies: i) the rules on "notability", documenting that information must come from secondary sources, as for example major academic journals; ii) a neutral point of view (NPOV): Wikipedia collaborators should be impartial to every single item, and all external reviews should be easily traced; iii) all texts should follow the GNU Free Documentation License (GFDL), and thus be freely used, distributed and copied, under the condition of the authorship attributed, and any changes logged; iv) there are several filters, blocks for the creation of specific web pages and checking users' pages procedures in order to defends Wikipedia from attacks of vandalism (http://en.wikipedia.org/wiki/Wikipedia).

The encyclopedia is supported by a non-profit foundation called the Wikimedia Foundation that helps other parallel projects such as Wiktionary and Wikibooks (http://en.wikipedia.org/wiki/Wikipedia).

Albeit Internet is mostly used to gather information, in our knowledge, no specific study has been conducted to estimate the use of Wikipedia for professional education. Given convincing characteristics, the use of this device is known to be widely used by students, nurses and also doctors. This observation raises a deep concern about the quality of information for professional use. This is the reason why we conducted a study aimed at evaluating the scientific quality of the information provided by Wikipedia, by comparing the information found in Wikipedia with scientific literature. We chose hospital acquired infections as topic for our exercise because it appears to be of large interest for several categories of health professions, not only limited to physicians.

Hospital Acquired Infections

Hospital acquired infections (HAIs) are infections occurring in a patient during the process of care in a health-care facility which was not present or incubating at the time of admission. This includes infections acquired in the hospital but appearing after discharge, and also occupational infections among staff [6].

It is estimated that in the US HAIs affect every year about 2 million patients [7], with a risk at admission ranging from 5.1% and 11.6%, whereas the estimated prevalence is 7.1% in European countries [8].

Several factors can affect HAIs' onset: condition of immunodeficiency, invasive procedures, multidrug-resistant bacteria (due to prolonged antibiotic treatment), and surgical interventions (the incidence of infection of the surgical site ranges from 1.2 to 23.6 per 100 surgical procedures in developing countries) [9]. The urinary and respiratory systems are the most affected.

Apart from more severe consequences, HAIs result in a prolonged hospital stay, with a consequent long term disability that can lead to an increased resistance of microorganism to antimicrobials. These factors lead to a massive additional financial burden for health system, a high cost for patients and their families and unnecessary deaths [7]. The average cost attributable to each case of HAI has been estimated to range from 1 006 US$ for urinary tract infections to 36 441 US$ for Bloodstream infections [10].

Health care organizations are increasing resources in order to tackle HAIs, both on the scientific and economic point of view, but HAIs remain one of the most important causes of death in hospitals [7].

METHODS

This study was carried out by 10 medical students as a curricular activity of the "Public Health, Occupational Health and Evidence-Based Medicine" course of the fifth-year of the School of Medicine of Avogadro University – Novara.

The first step of the work was the search and analysis of the message content of the English version of Wikipedia in relation to HAI, also called "nosocomial infections".

A Wikipedia search in the site http://en.wikipedia.org, using as keywords, "nosocomial infection" OR "hospital infection" OR "hospital acquired infection", retrieved 347 articles. Excluding those articles that did not include the main keywords in their overview, resulted in 100 articles. Two of us independently excluded the articles presenting the following characteristics: not having a main focus on nosocomial infections, to be a single case reports or a personal medical experience. Finally, 15 articles have been selected for the study (Appendix 1). The texts of the selected articles have been downloaded on 23rd November 2010.

The structure of selected articles was then analyzed. In particular, the following characteristics have been extracted: the completeness of the overview, the presence of a table of contents, the word count, the Wikipedia quality score (A=the article is well-organized and essentially complete, having been reviewed by independent reviewers; B=the article is mostly complete, but requires some further work to reach a higher class; C=the article is substantial, but still missing important content or contains irrelevant materials); START=an article that is being developed, but still incomplete and may require further reliable sources; ND=it is not possible to determine the article class because it is not featured), the Neutral Point of view imposed by Wikipedia.

Afterwards, two of us independently extracted the main messages contained in each article, in relation to the prevention of nosocomial infections; 51 messages, repeated 60 times, have been selected, and then analysed. The messages have been described using the following criteria: scientific references (scientific journals, whether PubMed-indexed or not, other references, no reference), quality of description (comprehensiveness of interventions for prevention/treatment), description of benefits, risks and side effects of each recommended procedure, additional sources for documentations, scientific agency sites, or to organizations with conflicts of interest or just Wikipedia.

The second step was the search for the scientific evidence regarding interventions to prevent nosocomial infections.

A Google search for guidelines for the control of nosocomial infections was conducted in March 2011 using the following keywords: "guidelines" AND ["nosocomial infection" OR "hospital infection"]. About 294 000 documents

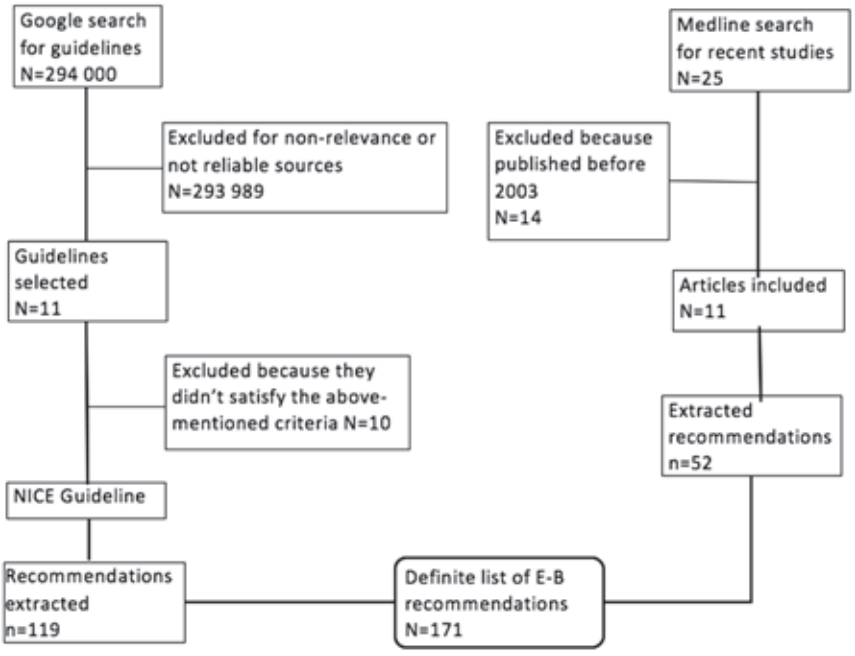
were found. A screening of the first 10 pages (100 documents), ordered by relevance, by selecting English language, governmental institutions and well known public health organizations, resulted in 11 documents. In order to state a list of single recommendations to be compared to the Wiki messages, we chose the NICE guideline "Infection Control: Prevention of healthcare-associated infections in primary and community care" (2003) because of its organisation (clear organisation in chapters: hand hygiene, protective equipment, safe use of needles, education of personnel and carers, catheters, enteral feeding and central venous catheters), for its transparent grading process, its easy access to the evidence by means of published systematic reviews accessible in the website, the authoritativeness of the agency. This guideline contains 119 recommendations, which has been used as benchmark to evaluate Wiki messages. Especially, there were 26 recommendation having a level of evidence "A".

In order to find more recent evidence, a literature search was carried out in Medline database using the following search strategy: "prevention and control"[Subheading] AND "Infection"[Mesh]) AND "Hospitals"[Mesh] AND ("humans"[MeSH Terms] AND (Practice Guideline[ptyp]) AND (English[lang] OR Italian[lang]). The search resulted in 25 articles, but only 11 were selected because we limited the search to the papers published after 2003. The 10 papers dealing with items which were not considered in the previously mentioned guidelines were then included (Appendix 2). The additional papers were scanned by two of us independently in order to extract the recommendations to be added to the list coming from the NICE guidelines. The recommendations were selected depending on the main chapters lacking in our guideline. The number of selected recommendations was 52. The recommendations extracted from the articles were then added to those coming from the NICE guideline by appending them at the end. In particular all the indications related to ventilation associated pneumonia (VAP), surgical site infection (SSI), methicillin-resistant *Staphylococcus aureus* (MRSA) and *Clostridium difficile*, came from the articles found in the Pubmed search. The final number of recommendations was 171 (Figure 1).

After the lists of the evidence-based recommendations (based on NICE guideline and scientific literature) and the one of Wikipedia messages have been established, we performed

FIGURE 1

FLOW-CHART OF THE SEARCH FOR INFORMATION COLLECTED FROM THE SCIENTIFIC LITERATURE



the comparison between the two lists, using the former as reference. The comparison has been carried out by two of us, and the evidence-based recommendations have been classified as perfectly matched with one or more Wiki messages (+++ in the tables), partially matched (++ in the tables), matched but with a severe incompleteness (+) or not matching to any Wiki message (-).

The Wiki messages without any correspondence in the evidence-based list have been listed in a separate table.

RESULTS

From Wikipedia search 15 articles targeted at the prevention and control of Hospital Acquired Infections were extracted. They have been downloaded on 23rd November 2010, and their characteristics analyzed.

No articles received a A-Class classification by Wikipedia organization, whereas 8 were of B-Class (53.3%), 3 articles of C-Class (20%), 4 articles of Start-Class or Stub (26.7%). A clear abstract was present in 5 articles (33.3%), a not exhaustive abstract in 7 (46.7%) and no abstract in 3 (20%) (Table 1).

The absolute number of scientific references varied from 2 to 87 (30 on average). Six articles have a number of citations of 0-25 (40%), 4 articles have 26-50 (26.7%), 5 articles have more than 50 (33.3%) (Table 1).

From the 15 Wiki articles, 51 different messages related to prevention and control of HAIs relevant for the professionals was extracted, 3.2 on average in every article. Extracted messages were variably supported by scientific evidence: 25.5% showed a reference to a major scientific journal, 29.4% a reference to a minor journal indexed in Medline, 23.5% showed references to a grey document or to a non-indexed journal, whereas 21.6% did not show any scientific reference (or references to newspapers or magazines).

The expected benefits of the interventions are clearly expressed with specific indications in 20.3% of messages, partially 43.8%, while not indications were reported in 35.9% of them. Disadvantages of interventions were partially described in 36.5% of messages and not described in 63.5% of them.

The comparison with recommendations extracted from the scientific literature (NICE guidelines plus Medline search) showed that: 28 messages in Wikipedia had no agreement (54.9%), 11 messages dealt with the same argument in scientific literature (21.6%), 8 messages were similar but did not match guidelines recommendations (15.7%), 2 messages disagreed with scientific literature or had important inaccuracies (3.9%), and 2 had different degree of congruence with the guidelines (3.9%).

The reliability of Wikipedia showed that 2 messages (3.9%) were not supported by studies confirming the validity or supported by works which did not agree with the scientific literature or with important inaccuracies. In 28 messages (54.9%), taken from Wikipedia, the authors guaranteed the effectiveness but was not confirmed by the description of studies in which the same information was demonstrated. The effectiveness of 16 messages (31.4%) was supported by the presence of a lot of scientific evidence; in 2 messages (3.9%) different level of effectiveness were reported. Moreover one works lacks of indications whether the intervention is correct or there were discordant studies; while in another one the effectiveness was reported without the studies supporting these information.

Concerning accuracy 2 messages of Wikipedia (3.9%) had the same accuracy of the guidelines, in 2 different articles.

Twenty-seven (52.9%) Wikipedia messages were not present in guidelines: 11 of them

TABLE 1

INDICATOR OF INTERNAL QUALITY OF THE 15 WIKI ARTICLES SELECTED FOR THE ANALYSIS

OVERVIEW	N	%
WIKI QUALITY		
A-Class	0	0
B-Class	8	53.3
C-Class	3	20
Start-Class or Stub	4	26.7
ABSTRACT		
Clear abstract	5	33.3
Not exhaustive abstract	7	46.7
No abstract	3	20
NUMBER OF CITATIONS		
0-25	6	40
26-50	4	26.7
51+	5	33.3
TOTAL	15	100

were supported by important effectiveness trials, 12 by a lower number of studies, the level of evidence of 4 of them was not reported. The remaining 24 Wikipedia messages could also be found in guidelines (47.0%): 6 were supported by effectiveness trials, 17 were supported by weaker evidence (69.6%), one of them was not supported by clear evidence.

Overall we extracted 51 health messages from Wikipedia, as well as 171 recommendations from scientific literature.

The scientific literature recommendations concerned three main areas of intervention: personnel and relatives (n=100; 58.5%), devices (n=63; 36.8%) and environment (n=8; 4.7%)

Among the recommendations for interventions on environment (Table 2.1), 50.0% (n=4) came from the NICE Guideline, and 50.0% from the scientific update (n=4). Two out of the 8 recommendations (25.0%) found a good agreement among the Wiki messages, whereas the other did not find any correspondent message.

Among the recommendations on "Personnel and relatives" (Table 2.2), 55 out of 100 (55.0%) came from the NICE guidelines, and 14% were graded as A. Eight recommendations (8%) found a perfect concordance (+++) in Wiki messages, and 8 (8%) found a good agreement (++), whereas 1 (1%) reached a lower agreement level (+).

Devices issue encompassed 63 recommendation (Table 2.3), 61 of them coming from the NICE guideline, and 19.7% being classified as level A. Only 2 out of 63 scientific recommendations found a Wikipedia message matching, with a perfect and low level of agreement (+++ and +). No recommendations graded A were found in Wiki.

As a whole, only 21 out of 171 scientific recommendations (12.3%) found a correspondence in Wikipedia health contents, 9 (42.9%), 10 (47.6%) and 2 (9.5%) with perfect (+++), good (++) and low (+) agreement respectively (Table 3).

Most part of the level A recommendations were part of the "personnel and relatives" type of intervention (n=13; 8.2%) of the "devices" section (n=12; 7.0%) (Table 4).

DISCUSSION

"Personnel and relatives" was the issue that encompassed most of the scientific literature evidence (n=17; 80.9%) whereas Wikipedia matched only 2 (9.55%) recommendations either in environment or in devices issues. Wikipedia messages reached the highest level of agreement in "personnel and relatives" section with 8 (88.9%) level (+++) and 8 (80%) level (++), this section collected the highest number of scientific update recommendations without correspondence in Wikipedia health contents (n=83; 55.3%).

TABLE 2.1

LIST OF THE RECOMMENDATIONS EXTRACTED FROM SCIENTIFIC LITERATURE, AND AGREEMENT WITH THE MESSAGES FOUND IN WIKIPEDIA – RECOMMENDATIONS TARGETED TO ENVIRONMENT

SECTION	SCIENTIFIC LITERATURE (U= SCIENTIFIC UPDATE; N=NICE GUIDELINE; A=GRADING A)	TYPE	AGREE
ENVIRONMENT (N=8; A=0; U=4)			
CD	Disinfection of equipment and environment	U	++
	Use sodium hypochlorite agents for environmental cleaning	U	++
HH	Hospital environment must be clean	N	-
	Increase cleaning in areas where pathogens are suspected to live	N	-
	Use hypochlorite in areas where pathogens are suspected to live	N	-
	Shared equipment must be decontaminated	N	-
MRSA	Ensure equipment and environment cleaning and disinfection	U	-
	Dedicated rooms	U	-

CD: Clostridium Difficile; **HH**: Hospital Hygiene; **MRSA**: Methicillin-Resistant Staphylococcus aureus

In this section Wikipedia matched Level A of evidence only once and cited it reaching the (++) agree level (n=1; 7.1%), 13 (92.9%) level A recommendation were not relevant with Wikipedia contents, hence scientific update were the most representative (n=9; 52.4%). Wikipedia cited those recommendation as follows: 5 (11.1%) reaching (+++) agree level, 4 (8.9%) reaching (++) agree level whereas 36 (80.0%) did not find any relevance.

TABLE 2.2

LIST OF RECOMMENDATIONS EXTRACTED FROM THE SCIENTIFIC LITERATURE, AND AGREEMENT WITH THE MESSAGES FOUND IN WIKIPEDIA – RECOMMENDATION TARGETED TO PERSONNEL AND RELATIVES

SECTION	SCIENTIFIC LITERATURE (U= SCIENTIFIC UPDATE; N=NICE GUIDELINE; A=GRADING A)	TYPE	AGREE
	PERSONNEL AND RELATIVES (N=27 A=9; U=2)		
CATH.	Remove cath. as soon as possible and used if clinically needed	N	-
	Select urethral and suprapubic cath. type after pt. characteristic assessment	N	-
	Cath. valve instead drainage bag in appropriate pt.	N,A	-
	Clean the urethral meatus with sterile normal saline before cath. insertion	N	-
	Single-use of appropriate lubricant for urethral insertion	N	-
	Use urinary sterile drainage or valve systems for indwelling cath. connections	N,A	-
	Use antibiotic prophylaxis in pt. with cath.-associated UTI history	N	-
	Document the need for catheterisation, cath. insertion and care	U	-
	Clean with water and stored dry reusable intermittent cath.	N	-
	Daily soap and water meatus washing	N,A	-
	Avoid bladder instillation or washout in pt. with cath.	N,A	-
	Educate pt. and relatives about their role	N	-
	Change cath. when clinically needed and as recommended by the manufacturer	N	-
	Decontaminate hands/wear and remove gloves before and after pt.'s manipulation	N	-
	Position urinary drainage bags below the bladder level but not on the floor	N	-
	Train and assess healthcare personnel's competence about aseptic procedures	N,A	-
	Infection rates are low using intermittent cath., especially hydrophilic cath.	N	-
	Obtain urine samples from a sampling port using an aseptic technique.	N	-
	Remove cath. as soon as possible (its continuation depends on clinically needed)	N	-
	Allow urinary outflow with the smallest gauge, use 10ml balloon in adults	N	-
	Consider alternative methods before using indwelling urinary cath.	U	-
	Choose intermittent catheterization if clinically appropriate and practical	N,A	-
	Ensure that the cath. to urinary drainage system connection is not broken	N,A	-
	Do not add antiseptic or antimicrobial solutions into urinary drainage bags	N,A	-
	Routine daily personal hygiene is enough to maintain meatal hygiene	N,A	-
	Healthcare workers must be trained in cath. insertion and maintenance	N	-
	Empty or change drainage bag to prevent urinary reflux and to maintain flow	N	-

Cath: catheters; **pt.**: patient; **UTI**: urinary tract infections

TABLE 2.2 (CONTINUED)

CROSS-TABULATION BETWEEN KNOWLEDGE AND MEDICAL AREA OF WORK			
SECTION	**SCIENTIFIC LITERATURE (U= SCIENTIFIC UPDATE; N=NICE GUIDELINE; A=GRADING A)**	**TYPE**	**AGREE**
PERSONNEL AND RELATIVES (CONT.D) (N=50; S=24; A=2)			
VAP	Education of personnel about VAP	U	++
	Education of personnel about NIV	U	++
	Maintain pt. in semirecumbent position	U	+++
	Perform regular antiseptic oral care	U	+++
	Use of appropriate endotracheal tubes	U	+++
	Avoidance of practises increseasing risk	U	-
	Do not routinely use rotational therapy	U	-
	Do not routinely administer prophylactic antimicrobials	U	-
	Avoid implement exstubation and reintubation	U	-
	Prefer oral to nasotracheal intubation	U	-
CD	Isolate infected pt.	U	-
	Use gloves	U	+++
	Use gowns	U	-
	Conduct CD infection surveillance	U	-
	Education about prevention	U	-
	Be compliant hand hygiene CDC and WHO guidelines	U	++
	Do not test pt without signs or symptoms of CD infection	U	-
	Do not repeat CD testing after a successful therapy	U	-
	Intensify the assesment of compliance	U	-
	HW before living pt's room	U	-
	Isolate pt. with diarrhea	U	-
	Prolong the precautions in case of high risk pt. for CD infection	U	-
	Begin antimicrobial program in suspected CD infection	U	-
	Do not give CD's prophylactic therapy	U	-
HH	Education of workers about environmental hygiene	N	-
PE	Education of personnel about PE	N	-
	PE should be always available	N	++
	Use gloves during dangerous procedures	N	-
	Employ single use gloves	N	+++
	Wash hands after using gloves	N	+++
	Use plastic aprons during contaminating procedures	N	-
	Employ single use aprons	N	-
	Use full-body fluid-repellent gowns in dangerous procedures	N	-
	Use face masks and eye protection	N	-
	Do not use powdered nor polythene gloves	N	-
	Respiratory protective equipment must be correctly used	N	-
HW	Decontaminate hands before and after each contact with pt.	N	++
	Wash visibly dirty hands with soap	N,A	++
	Wash hands between different procedures	N,A	-
	Use alcohol handrub and then wash hand with soap	N	-
	Hands should be adequate to keep the correct hygiene	N	-
	Train personnel to the correct HW technique	N	++
	Handrubbing properly	N	+++
	Train personnel to keep the integrity of their skin	N	+
	Avoid to use irritanting soap	N	-
	Alcohol-based handrub should be available nearby each pt.	N	-
	Inquire reguraly the compliance to HW	N	-
	Educate personnel to HW	N	-
EF	Educate pt., careers and personnel	N	-
	Decontaminate hands before starting feed preparation	N,A	-

VAP: ventilator associated pneumonia; **NIV:** non invasive ventilation; **pt:** patient **CD:** Clostridium Difficile; **HW:** Hand Washing; **HH:** Hospital Hygiene; **PE:** Protective Equipment; **EF:** Enteral Feeding

TABLE 2.2 (CONTINUED)

CROSS-TABULATION BETWEEN KNOWLEDGE AND MEDICAL AREA OF WORK			
SECTION	SCIENTIFIC LITERATURE (U= SCIENTIFIC UPDATE; N=NICE GUIDELINE; A=GRADING A)	TYPE	AGREE
PERSONNEL AND RELATIVES (CONT.D) (N=23;A=2; U=19;)			
SSI	Surveillance of SSI	U	-
	Prophilaxis in accordance with EBM or Guidelines	U	+++
	Do not cut or remove hair if those will not interfere	U	-
	Glicemic control during postoperative cardiac surgery	U	-
	Surgery healthcare, pt. and families prevention and education	U	-
	Use vancoumycin only in specific clinical circumstances	U	-
	Do not routinely delay surgery to provide parenteral nutrition	U	-
CVC	Assess competence and adherence or ensure personnel's training to IPP	N	-
	Teach any prevention techniques to pt. and carers before discharge	N	-
	Decontaminate hands previously either with antimicrobial liquid or alcohol handrub	N,A	-
	Wash visibly soiled or contaminated hands with liquid soap before alcohol handrub use	N,A	-
MRSA	Conduct risk assessment, educate personnel, pt. and relatives	U	-
	Implement an MRSA monitoring program	U	-
	Promote CDC and WHO recommendations	U	-
	Use contact precautions for colonized or infected patients	U	-
	Implement a notification system for new colonized or infected pt.	U	-
	Personnel's active surveillance and screening in case of transmission evidence	U	-
	Chlorhexidine routinary ICU pt. bathing in case of transmission evidence	U	-
	Pt. decolonization therapy in conjuction with active surveillance	U	-
	Repeat testing three times in non-exposed pt.	U	-
	Use appropriate disinfecting agents	U	++
	Dedicated noncritical pt. care items	U	-
N	Educate all staff's members about the safe sharps usage	U	-

SSI: Surgical Site Infections; **CVC**: Central Venous Catheter; **pt**: patient; **IPP**: infection prevention practices; **MRSA**: Methicillin-Resistant Staphylococcus Aureus ; **N**: Needles; **ICU**: intensive care unit

The aim of this work was to analyse whether Wikipedia can be considered a good source for the scientific update of the health personnel concerning the topic of the Nosocomial Infections, by comparing the messages contained in the most relevant Wikipedia items with a list of evidence-based recommendations extracted by high quality guidelines upgraded by a search in scientific literature.

45.1% of Wikipedia's messages were even found in the guidelines. On this percentage, 21.6% completely agreed with the messages of the guidelines, 15.7% partially agreed, 3.9% disagreed and 3.9% showed different level of evidence in different articles. Moreover, 54.9% of Wikipedia's messages were not included in the guidelines and 84.2% of the recommendations contained in the guidelines were not present in Wikipedia.

We have to consider that if on the one hand Wikipedia has an updating much more frequent than the NICE guidelines, on the other hand this updating is not performed only by medical personnel. For this reason, the quality and the importance of the recommendations present in Wikipedia is not so reliable as the ones present in the NICE guidelines. The messages of the NICE which are not present in Wikipedia are about issues with an important impact on the prevention of hospital infections and the majority has an high evidence-class. However the messages present in Wikipedia but absent in the NICE guidelines are mostly about marginal issues or not validated techniques (Box 1). The ones concerning important items have been

compared with the relative guideline from PubMed. We found no contrast between the messages from the two sources.

All the articles have been downloaded in the same day; all the modifications occurred after that date have not been considered. The initial selection of the articles have been performed by using string as wide and exhaustive as possible.

TABLE 2.3

LIST OF THE RECOMMENDATIONS EXTRACTED FROM THE SCIENTIFIC UPDATE, AND AGREEMENT WITH THE MESSAGES FOUND IN WIKIPEDIA – RECOMMENDATION TARGETED TO DEVICES AND DEVICE USE

SECTION	SCIENTIFIC LITERATURE (U= SCIENTIFIC UPDATE; N=NICE GUIDELINE; A=GRADING A)	TYPE	AGREE
DEVICES (N=41; A=4; U=2)			
VAP	Education of personnel about VAP	U	-
PE	Select appropriately protective equipment	N	+++
	Use CE marked gloves	N	-
	Latex free gloves must be available	N	-
CATH.	Choice of cath. material depending on the most suitable	N	+
N	Minimized direct sharps handling	N	-
	N. must not be recapped, bent, broken or disassembled	N	-
	Discard used sharps into an appropriate container at the point of use	N	-
	Dispose sharp bins at the safest height for staff and children	N	-
	Consider needlestick prevention devices with effectiveness evidences	N	-
	Widespread needlestick-prevention devices only after a rigorous evaluation	N	-
MRSA	Routinary review of data from specimens and if positive sent to microbiology laboratory	U	-
EF	Pre-packaged, ready-to-use feeds better than decanting, reconstitution or diluition feeds	N,A	-
	Choose minimal handling assemblage and EF feeding tube systems	N	-
	Mix feeds with sterile water and a no touch technique	N	-
	Discarded feed containers after each single feeding session	N	-
	Wash and dry every day the stoma	N	-
	Feeds pre-prepared may be stored in a refrigerator and used within 24 hours	N	-
	Minimal handling and an ANTT to connect the EF feeding tube system	N	-
	Administer ready-to-use feeds within 24 hours and reconstituted feeds in 4 hours	N	-
	Flush EF tube before and after feeding or medications administration with water	N	-
CVC	Disinfect insertion site with single-use antiseptic solution or individual package	N	-
	Follow the manufacturer's recommendation for changing needle-free components	N	-
	Ensure replacing solution administration sets in continuous use at 72 hours intervals	N,A	-
	Administer parental nutrition via an exclusive port of a multilumen cath.	N	-
	Do not routinely replace cath. as a method to prevent cath.-related infection	N,A	-
	Personnel should ensure about compatibility and safety of needle-free devices	N	-
	In-line filters should not be used routinely for infection prevention purposes	N	-
	Use ANTT	N	-
	Use maximal sterile barriers	N	-
	Use iodine solution in allergic chlorexidine pt	N	-
	Avoid organic solvents before insertion	N	-
	Avoid routine antimicrobial ointment as site care	N	-
	Cover cath. insertion site with polyurethane dressing	N	-
	Avoid routine systemic anticoagulants	N	-
	Use CVC material compatible site care devices	N	-
	Administer parenteral nutrition via an exclusive port of a multilumen cath.	N	-
	Do not routinely apply antimicrobial ointment prior insertion	N	-
	Change transparent setting every 7 days or sooner if needed	N	-
	Assess the needed or change gauze dressing every day	N	-
	Use a tunneled or implanted CVC in long-term vascular access pt.	N,A	-

VAP: ventilator associated pneumonia; **PE**: Protective Equipment; **Cath.**: catheters; **N**: Needles;
MRSA: Methicillin-Resistant Staphylococcus Aureus; **EF**: Enteral Feeding;
ANTT: Aseptic Non-Touch Technique; **CVC**: Central Venous Catheter; **pt**: patient

Moreover, a double-blinded method have been used for the further selection of the definitive articles. All the messages have been extracted according to keywords and criteria previously discussed and approved by all members and have been analysed by using a comparison table. NICE guidelines have been chosen because they were the most recent, exhaustive, complete guidelines

TABLE 2.3 (CONTINUED)

CROSS-TABULATION BETWEEN KNOWLEDGE AND MEDICAL AREA OF WORK			
SECTION	**SCIENTIFIC LITERATURE (U= SCIENTIFIC UPDATE; N=NICE GUIDELINE; A=GRADING A)**	**TYPE**	**AGREE**
DEVICES (CONT'D) (N=22; A=8; S=0)			
CVC	Use an antimicrobial impregnated CVC in high risk pt. of cath.-related infection, who require short term CVC	N,A	-
	In decision making of insertion site, consider either both the risk of infection or the mechanical complication	N	-
	Subclavian site instead jugular or femoral sites if not otherwise recommended	N	-
	Implantable devices for long-term or intermittent CVC pt.; tunneled devices for regular or continuous CVC pt.	N	-
	Decontaminate skin previously with a single-use application of chlorexidine antiseptic	N,A	-
	Use sterile gauze dressing for profuse perspiration or bleeding or oozing	N	-
	Wear clean or sterile gloves and use ANTT in any medical procedure	N	-
	Change transfusional administration sets when the episode is complete or every 12 hours (if not otherwise recommended)	N	-
	Manage pt. using a single-lumen cath. if not otherwise recommended	N,A	-
	Insert a new cath. over a guide wire if cath.-related infection is suspected, change site and use a new CVC in case of infection evidence	N,A	-
	Do not use guide wire assisted cath. exchange for pt. with cath.-related infection	N,A	-
	Replace all fluid administration tubing and connectors when the CVC access device is replaced	N	-
	Decontaminate injection port or cath. hub before and after its usage using chlorexidine solution if not otherwise recommended	N	--
	Use guide wire assisted cath. exchange to replace a malfunctioning cath.	N,A	-
	Minimise contamination risk using chlorexidine solution (if not otherwise recommended) when needle-free devices are used	N	-
	Change total parenteral nutrition administration sets every 24 hours (if not otherwise recommended)	N	-
	Avoid routine administration of intranasal or systemic antimicrobials before insertion or during the usage	N	-
	Use sterile 0.9 % Na chloride for injection to flush and lock cath. lumens frequently used	N,A	-
	Dressings used on tunneled or implanted cath. insertion sites should be replaced every 7 days until the insertion site has healed	N	-
	Use heparin Na flush solution to flush and lock implanted or opened-ended cath. if recommended by the manufacturer	N	-
	Monitor needle-free devices for occurrence of associated infection and report to local agency if suspected	N	-
	Clean cath. insertion site with chlorexidine solution if not otherwise recommended	N,A	-

CVC: central venous catheter; **pt.:** patient;**cath.**: catheters; **ANTT:** Aseptic Non-Touch Technique

Legend	
+++	perfect concordance between NICE guidelines and WMS code
++	good concordance, but WMS code is missing some information
+	WMS is missing important information, or is really inaccurate
-	there isn't WMS about NICE guidelines subject

TABLE 3

AGREEMENT BETWEEN THE SCIENTIFIC UPDATE AND THE WIKI RECOMMENDATIONS BY SETTING (ENVIRONMENT, PERSONNEL AND RELATIVES, DEVICES)

	+++	++	+	-	TOTAL
ENVIRONMENT	0	2	0	6	8
PERSONNEL AND RELATIVES	8	8	1	83	100
DEVICES	1	0	1	61	63
TOTAL	9	10	2	150	171

Legend	
+++	perfect concordance between NICE guidelines and WMS code
++	good concordance, but WMS code is missing some information
+	WMS is missing important information, or is really inaccurate
-	there isn't WMS about NICE guidelines subject

TABLE 4

SUMMARY OF LEVELS OF AGREEMENT

		AGREE LEVEL									
		+++		++		+		-		TOTAL	
ISSUE	type	n.	(%)	n.	(%)	n.	(%)	n.	(%)	n.	(%)
ENVIRONMENT	A	.	.	.	.	.	.	.	.	.	
	U	.	.	2	100.00	.	.	2	33.33	4	
	other level	.	.	.	.	.	.	4	66.67	4	
	total	.	.	2	25.00	.	.	6	75.00	8	4.68
-PERSONNEL AND RELATIVES	A	.	.	1	7.14	.	.	13	92.86	14	8.19
	U	5	11.11	4	8.89	.	.	36	80.00	45	26.32
	other level	3		3		1		34	82.93	41	23.98
	total	8	8.00	8	8.00	1	1.00	83	83.00	100	58.48
DEVICES	A	.	.	.	.	.	.	12	19.67	12	7.02
	U	.	.	.	.	.	.	2	3.28	2	
	other level	1	2.04	.	.	1	2.04	47	95.92	49	28.65
	total	1	1.59	.	.	1	1.59	61	96.83	63	36.84
NOT FITTED	A									0	
	U									0	
	other level									0	
	total									0	
TOTAL		9	42.86	10	47.62	2	9.52	150	87.72	171	100

concerning Nosocomial Infection; moreover they have been integrated with the PubMed guidelines in relation to the few topics not contained in the NICE but present in Wikipedia. The absence of some messages in the NICE guidelines could be due to: elimination of some scientific sources according to a chronological criteria; a more administrative-behavioural and less clinical address of the guidelines; lack of an update of guidelines regarding recently published messages.

For this reason the selected articles should be considered a representative sample of Wikipedia's information and the NICE

BOX 1

WIKIPEDIA'S MESSAGES NON FITTED IN NICE GUIDELINES
Handwashing Use of handwashing signals, exposed all around healthcare settings, to remind personnel and visitors the correct procedure
Clostridium difficile C. difficile anti-toxoid vaccine reduces CDI incidence
VAP Place feedings tubes beyond the pylorus
Protection Equipement Patient should wear an apron during the admission
MRSA Use of colloidal silver in medicating wounds is effective against MRSA

guidelines represent a reliable source about the issue analysed.

Nowadays in the scientific literature is present only few articles analyzing the reliability of Wikipedia as sources of medical information [12]. According to some authors the quality of the healthcare information provided by Wikipedia is comparable to scientific literature [13]; in fact some scientific groups affirmed that the English Wikipedia is a prominent source of online health information compared to the other online health information providers studied [12]. On the other hand, especially regarding pharmacological information, Wikipedia is less complete, and has more errors of omission than the comparator database and this leads to the conclusion that Wikipedia may be a useful point of engagement for consumers, but is not authoritative and should only be a supplemental source of drug information [13].

Anyway the results of this work should not be generalized to all items of Wikipedia because they concerns only a very specific field.

Thanks to the results we reached, we can affirm that Wikipedia is a good source for general information and prevention of nosocomial infections, but at the same time it does not represent a reliable source of updating and improving for the general practitioners, the specialists and for the health workers. Wikipedia is an accessible source, easy to understand and to use for researches and, above all, it is free, contrary to many guidelines or scientific articles. Nonetheless the most discussed topics and consequently their updating are also the most popular ones or those debated in the media. This gives birth to a variation of the quality of Wikipedia's articles, which is too strictly dependent on the topics discussed. Moreover, Wikipedia promotes the use of innovative materials and techniques for the prevention of nosocomial infections, which are not discussed in the scientific literature. This leads to the conclusion that there should have been a sort of "push" of the pharmaceutical companies in sponsoring this products.

Finally we should consider the possibility of further studies on Wikipedia, as demonstrated by the fact that 90% of the items contains messages supported by more than one bibliographic references.

Other members of the Avogadro Wikipedia and HAI Group: Sara Cardani, Matteo Castagno, Mattia Colli, Guido Merlotti, Elena Momo, Andrea Pedrotti, Arianna Rossini.

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APPENDIX 1 - WIKIPEDIA ITEMS INCLUDED IN THE STUDY

Antibiotic resistance
http://en.wikipedia.org/w/index.php?title=Antibiotic_resistance&oldid=398657888

Antimicrobial properties of copper
http://en.wikipedia.org/w/index.php?title=Antimicrobial_properties_of_copper&oldid=398258311

Beta-Glucan
http://en.wikipedia.org/w/index.php?title=Beta-glucan&oldid=397770486

Clostridium difficile
http://en.wikipedia.org/w/index.php?title=Clostridium_difficile&oldid=398652968

Fomite
http://en.wikipedia.org/w/index.php?title=Fomite&oldid=397184408

Hand Sanitizer
http://en.wikipedia.org/w/index.php?title=Hand_sanitizer&oldid=398556850

Hand Washing
http://en.wikipedia.org/w/index.php?title=Hand_washing&oldid=398550778

Infection Control
http://en.wikipedia.org/w/index.php?title=Infection_control&oldid=392405073

Legionellosis
http://en.wikipedia.org/w/index.php?title=Legionellosis&oldid=399022924

Medical uses of silver
http://en.wikipedia.org/w/index.php?title=Medical_uses_of_silver&oldid=396539258

Necktie
http://en.wikipedia.org/w/index.php?title=Necktie&oldid=398757456

Nosocomial Infection
http://en.wikipedia.org/w/index.php?title=Nosocomial_infection&oldid=398440052

PatientPack
http://en.wikipedia.org/w/index.php?title=PatientPak&oldid=394087913

Staphylococcus aureus
http://en.wikipedia.org/w/index.php?title=Staphylococcus_aureus&oldid=398945066

Ventilator-associated pneumonia
http://en.wikipedia.org/w/index.php?title=Ventilator-ssociated_pneumonia&oldid=391963964

APPENDIX 2 - REFERENCES OF THE SCIENTIFIC LITERATURE

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