

Commentary

World wide web resources on control of nosocomial infections

Ilias I Siempos¹, Konstantinos N Fragoulis¹ and Matthew E Falagas^{1,2}

¹Alfa Institute of Biomedical Sciences (AIBS), Neapoleos Street, 151 23 Marousi, Athens, Greece

²Department of Medicine, Tufts University School of Medicine, Washington Street, 02111 Boston, Massachusetts, USA

Correspondence: Matthew E Falagas, m.falagas@aibs.gr

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Abstract

Nosocomial infections are a major worldwide cause of death and disability, infection control programs are effective in limiting these infections, especially those acquired in the intensive care unit. The development of the world wide web has provided health care professionals with immediate access to continuously updated information in the field of infection control. We sought to identify websites that contain information on nosocomial infection control by using popular internet search engines, such as Google, Yahoo and AltaVista, and by reviewing relevant publications identified in the PubMed and Current Contents databases. Only those sites that were English language, open access, and developed by a government, academic institution, or national or international scientific association were eligible for inclusion. From a vast number of internet sites initially identified, we selected 49 that provide information on infection control for inclusion in our list of practical and relevant internet resources. Several sites provide general information on infection control practices, whereas others focus on one or a few specific infection(s). We provide health care professionals with a timely and succinct list of open access internet resources that contain information regarding the prevention and control of nosocomial infections in order to help in the dissemination of relevant information and so contribute to the limitation of such hazards.

Introduction

Nosocomial infections (NIs) are a major worldwide cause of death and disability, according to estimates reported by the World Health Organization [1]. Up to 15% of hospitalized patients suffer from infections associated with health care [2]. In addition, in the EPIC (European Prevalence of Infection in Intensive Care) study [3], Vincent and coworkers reported that the prevalence of NI in 1417 European intensive care units was 20.6% in 1992. Several studies focusing on the impact of NIs on health care revealed that they are responsible for increased mortality, morbidity, and length of hospital and intensive care unit stays [4,5].

NIs appear to be an unavoidable toll that we must pay while we attempt to manage patients aggressively using the latest technologies, including invasive devices. However, at least a

third of NIs are preventable through infection control programs, as suggested by the SENIC (Study on the Efficacy of Nosocomial Infection Control) study from the US Centers for Disease Control and Prevention [6]. Because there is ample evidence of the effectiveness of infection control programs [6-8], an understanding of such programs and of their incorporation into everyday clinical practice is mandatory.

The need for education and constant updating of infection control measures may now be achieved with the use of modern technology, including the internet and world wide web. However, navigation of the world wide web to gain valuable information from reliable sources is recognized not to be easy [9]. Thus, we endeavored to identify various electronic sources on matters of prevention and control of NIs, and to compile a list of major websites as a guide for interested health care professionals.

Method

Popular internet search engines, including Google, Yahoo and AltaVista, were used to identify websites that provide information regarding the control of NIs. Broad search terms such as 'infection control' were used to identify a large number of relevant websites. The first 100 hits on each search engine were further reviewed. A number of the identified sites provided links to other sites, which are also included in this review.

PubMed and Current Contents were also extensively searched by using the following search strategy: 'infection control' AND 'world wide web'.

To be included in our list, a website had to be developed by a government, academic institution, or a national or international health care professionals' association, as a guarantee of accuracy and overall validity of the information provided; personal sites or those maintained by commercial entities

NI = nosocomial infection.

Table 1

Open-access world wide web resources on control of nosocomial infections

Website title (country)	Web site address	Title of web page presenting information
National Library of Medicine (USA)	http://www.nlm.nih.gov	MedlinePlus: Infection control
Faculty of Medicine: University Catholic of Louvain (Belgium)	http://www.uclouvain.be/md.html	Infection control
Infection control today magazine (USA)	http://www.infectioncontrolday.com	Infection control programs
Association for Professionals in Infection Control and) Epidemiology (USA)	http://www.apic.org/AM/Template.cfm?Section=Home	Infectious disease centre. Practice guidance
Infection Control Nurses Association (UK)	http://www.icna.co.uk/	Public downloads
Yale-New Haven Medical Center (USA)	http://www.med.yale.edu	Yale-New Haven hospital infection control manual
Australian Government. Department of Health and Ageing (Australia)	http://www.health.gov.au	Infection control guidelines. Navigation page
National Institute for Health and Clinical Excellence (UK)	http://www.nice.org.uk/page.aspx?o=home	Infection control
Centers for Disease Control and Prevention (USA)	www.cdc.gov	Infection control in health care settings
National Health Service (NHS) plus - Health at work (UK)	http://www.nhsplus.nhs.uk/default.asp	NHS stuff. Infection control
Royal College of nursing (UK)	http://www.rcn.org.uk	Good practice in infection prevention and control
American Dental Association (USA)	http://www.ada.org/index.asp	Oral health topics. Infection control
World Health Organization	http://www.who.int/en/	Hospital hygiene and infection control
Public Health Agency of Canada (Canada)	http://www.phac-asp.gc.ca/new_e.html	Guidelines on infection control
NSW Health (Australia)	http://www.health.nsw.gov.au/	Infection control policy
Infection Control Department (USA)	http://infectioncontrol.ucsfmedicalcenter.org/	Infection control policy. Standard and transmission based precautions
Victorian Government Health information (Australia)	http://www.health.vic.gov.au/	Guidelines and regulations
Health protection agency (UK)	http://www.hpa.org.uk	Centre for infections
St. Joseph's Health Care, London (UK)	http://www.sjhc.london.on.ca	Infection prevention and control
UK National Audit Office (UK)	http://www.nao.org.uk	The management and control of hospital acquired infection in acute NHS trusts in England
Queensland Health (Australia)	http://www.health.qld.gov.au	Infection control
College of Nurses of Ontario (Canada)	http://www.cno.org	Infection prevention and control
Scottish Government, Scottish Executive (Scotland)	http://www.scotland.gov.uk/Home	Infection control standards for adult care homes
HIV Dent (USA)	http://www.hivdent.org	Infection control and postexposure protocols
National University of Ireland, Galway (Ireland)	http://www.nuigalway.ie	Infection control
Infection control services, University College, London hospitals (UK)	http://www.infectioncontrolservices.co.uk/Default.htm	Infection control philosophy
Gastroenterological Society of Australia (Australia)	http://www.gesa.org.au/index.htm	Infection control in endoscopy
Health protection Scotland	http://www.hps.scot.nhs.uk/index.aspx	Strengthening and co-ordinating health protection in Scotland
Imperial College of London (UK)	http://www3.imperial.ac.uk/	Control of infection: how to avoid damaging yourself and your patient
Harborview Medical Centre (HMC; USA)	http://www.uwmedicine.org/Facilities/Harborview/	HMC epidemiology/infection control
Infection control nurses of Connecticut (USA)	http://www.infectioncontrolct.org/	Infection control nurses of Connecticut
King County Government, Seattle, Washington (USA)	http://www.metrokc.gov/	Communicable diseases, epidemiology and immunization
The University of North Carolina at Chapel Hill (USA)	http://www.unc.edu	Resources on the internet on infection control
Infection Control Resource (USA)	http://www.infectioncontrolresource.org/	Infection control resource
William Fleming high school, VA (USA)	http://www.roanoke.k12.va.us/schools/Fleming/lawson/jgpage/weblesn.htm	Principles of infection control
Oregon Government (USA)	http://www.oregon.gov/	Acute and communicable disease prevention
Community and Hospital Infection Control Association (Canada)	http://www.chica.org/	Links and resources
Centers for Disease Control and Prevention (USA)	www.cdc.gov	Severe acute respiratory syndrome (SARS)
New York State (USA)	http://www.ny.gov/	Infection control
The Body: The Complete HIV/AIDS Resource (USA)	http://www.thebody.com/index.html	Infection control in the correctional setting
University of Virginia Health System (USA)	http://www.healthsystem.virginia.edu/	Infection control manual
Vanderbilt Medical Center (USA)	http://www.mc.vanderbilt.edu/	Department of Infection Control and Prevention
British Columbian Centre for Disease Control (Canada)	http://bccdc.org/divisionphp?item=11	Infection control guidelines
Florida Department of Health (USA)	http://www.doh.state.fl.us	Florida's health
Institute of algorithmic medicine (USA)	http://www.medal.org/visitor/login.aspx	The medical algorithms project. Infection control
The Chinese University of Hong Kong (China)	http://aic.cuhk.edu.hk/	Infection control
European Society of Intensive Care Medicine (Europe)	http://www.cobatrice.org	Patient safety and health systems management. Infection control
Johns Hopkins Medicine (USA)	http://www.hopkinsmedicine.org/index.html	Hospital epidemiology and infection control
Medical-Journals.com (UK)	http://www.medical-journals.com/	Infection control - a problem for patient safety

Website direct address	Comments
http://www.nlm.nih.gov/medlineplus/infectioncontrol.html	Provides infection control guidelines
http://www.md.ucl.ac.be/didac/hosp/infco.htm	A database of many articles with abstracts, published since 1 January 1994
http://www.infectioncontroltoday.com/category.asp/sectionID/403	Provides articles concerning infection control
http://www.apic.org/AM/Template.cfm?Section=Guidelines&Template=/TaggedPage/TaggedPageDisplay.cfm&TPLID=6&ContentID=519	Provides infection control guidelines.
http://www.icna.co.uk/publicdownloads/index.Asp	Mainly for members of the association
http://www.med.yale.edu/ynhh/infection/	Good collection of preventive measures for infection control
http://www.health.gov.au/internet/wcms/Publishing.nsf/content/icg-guidelines-index.htm	Infection control guidelines for the prevention of transmission of infectious diseases in the health care setting
http://www.nice.org.uk/page.aspx?o=CG002	Provides a set of measures to avoid infection that should be followed by anyone giving or receiving care at home or at a health centre
http://www.cdc.gov/ncidod/dhqp/index.html	Guidelines for keeping patients and health care workers in health care settings protected from infectious diseases
http://www.nhsplus.nhs.uk/nhsstaff/infection.asp	Limited information
http://www.rcn.org.uk/resources/mrsa/healthcarestaff/infectioncontrol/index.php	Guidance for nursing staff. Information on infection control and prevention
http://www.ada.org/public/topics/infection_control_faq.asp#3	Brief answers on dental health
http://www.who.int/water_sanitation_health/medicalwaste/148to158.pdf	Information on epidemiology and prevention of hospital infections
http://www.phac-aspc.gc.ca/dpg_e.html#infection	Contains guidelines on infection control
http://www.health.nsw.gov.au/policies/PD/2005/pdf/PD2005_247.pdf	Policy directive of the Australian Department of Health. Contains guidelines on hospital infection control
http://infectioncontrol.ucsfmedicalcenter.org/STD__Trans_Precautions_final.pdf	Contains guidelines on hospital infection control
http://www.health.vic.gov.au/ideas/regulations/index.htm	Infectious disease regulation and guidelines
http://www.hpa.org.uk/infections/default.htm	Carries out a broad spectrum of work related to prevention of infectious diseases
http://www.sjhc.london.on.ca/infectioncontrol/	Contains information on infection control
http://www.nao.org.uk/publications/nao_reports/9900230.pdf	General information on infection control and costs of hospital acquired infections
http://www.health.qld.gov.au/infectioncontrol/guidelines.html	Queensland government infection control guidelines
http://www.cno.org/docs/prac/41002_infection.pdf	Guidelines for nurses
http://www.scotland.gov.uk/Publications/2005/03/19927/42764#11	Provides infection control standards for adult care homes
http://www.hivdent.org/infctl/office.htm	Dental office issues
http://www.nuigalway.ie/bac/control_of_infection.htm	General information on infection control
http://www.infectioncontrolservices.co.uk/intro1.htm	Contains information on infection control
http://www.gesa.org.au/members_guidelines/endoscopy_inf/	Practice guidelines for endoscopic procedures
http://www.hps.scot.nhs.uk/scieh.asp	Contains infection control procedures
http://www3.imperial.ac.uk/OCCHEALTH/formedicalstudents/controlofinfection/	Basic principles of infection control
http://depts.washington.edu/ictrain/icmanual/	Infection control manual
http://www.infectioncontrolct.org/	Contains useful information and helpful links on infection control
http://www.metrokc.gov/health/providers/epidemiology/index.htm	Information for health care providers
http://www.unc.edu/depts/spice/resource.html	Contains many links
http://www.infectioncontrolresource.org/	Contains articles on prevention strategies for infection control practitioners and professional nurses
http://www.roanoke.k12.va.us/schools/Fleming/lawson/jgpage/infect.htm	An internet lesson to introduce health occupation students to infection control and prevention
http://oregon.gov/DHS/ph/acid/lhd/infectcontrol.shtml#genl	General disease control and antimicrobial resistance
http://www.chica.org/links_overview.html	Information on hand hygiene, bioterrorism and disasters. Needs subscription for further information
http://www.cdc.gov/ncidod/sars/ic-closecontacts.htm	Only for SARS. Limited information
http://www.health.state.ny.us/nysdoh/infection/infcontrol.htm	Guidelines on infection control
http://www.thebody.com/hepp/julaug04/infection_control.html?m59t	Information on HIV prevention
http://www.healthsystem.virginia.edu/internet/infection-control/	Contains infection control procedures
http://www.mc.vanderbilt.edu/root/vumc.php?site=infectioncontrol&doc=4616	Isolation guidelines, infection control policies
http://www.bccdc.org/content.php?item=194	Contains infection control guidelines and many links.
http://www.doh.state.fl.us/Disease_ctr/epi/icg/icg.pdf#search=%22%22infection%20control%22%20icu%20guidelines%22	Main focus is on pandemic influenza and avian flu
http://www.medal.org/visitor/www/inactive/ch26.aspx	Information on control of the majority of nosocomial infections. Requires registration
http://www.aic.cuhk.edu.hk/web8/SARS%20infection%20control.htm	Focus on SARS
http://212.149.150.161:8080/coba/results.jsp?sea=1&id=4&subid=11&li=0&subsubid=11.2	Contains practice guidelines on prevention of nosocomial infections
http://www.hopkinsmedicine.org/heic	Information on infectious diseases and their prevention
http://www.medical-journals.com/r037.htm	An article on nosocomial infections

were excluded. In addition, we selected only those sites that were written in English (alternative language options, if present, were mentioned, but absence of information in English was considered an exclusion criterion for the purposes of this article) and that offer free access (specifically, no paid registration is required to gain access to the full content of the site; sites requiring free registration for access were not excluded).

Results

A great many websites were initially identified using the specified search engines. In detail, the term 'infection control' yielded about 26,800,000 hits in Google, about 45,100,000 in Yahoo, and about 26,000,000 in Alta Vista. Of these we selected 44 websites; five additional sites, known to us, that were not captured through the initial internet search were added to the final list. Searches of the PubMed and Current Contents databases did not identify any additional websites.

In Table 1 we present the websites we selected based on the selection criteria outlined above. In all, our list contains 49 websites that provide information on infection control. Twenty-one of these sites were developed by governments, 15 by academic institutions, and 13 by health care professionals' associations. It is noteworthy that some interesting websites on the issue of infection control are derived from nurses' associations. The majority of the retrieved sites provide general information on infection control practices, whereas others focus on one particular infection, such as human immunodeficiency virus infection or severe acute respiratory syndrome.

We accessed each of the web addresses listed in Table 1 both to confirm accessibility and to verify that they contain accurate information on matters of infection control. Other characteristics of these resources, such as extent of content, subspecialty focus, and inclusion of specific guidelines, are summarized in the right-most column of the table.

Discussion

We attempted to provide health care professionals with a timely and succinct list of world wide web resources that contain valuable information on the prevention and control of NIs. Because websites containing information that is both accurate and accessible are considered to be the best [10], we aimed to include in our list only those websites with these features.

Our search was conducted to identify websites reporting on methods and techniques that are needed to prevent cross-contamination and to control potential sources of pathogens that could be transmitted from patient to patient or from health care professional to patient. Specifically, the listed websites include updated information on isolation, standard precautions (hand hygiene, wearing of gloves, mask and gowns, manipulation of sharp objects, and proper use of patient care equipment) and transmission-based precautions.

In addition to such measures, control of use of antimicrobial agents is a major component of hospital infection control, because antimicrobial abuse is known to enhance the development of resistant strains [11]. It was beyond the scope of this work to identify websites providing recommendations on the control of antimicrobial use. However, a good knowledge of local epidemiologic patterns and resistance profiles of prevailing pathogens is crucial to selecting appropriate antimicrobial treatment. Therefore, our research team recently reported on a collection of world wide web resources that include updated information on antimicrobial resistance patterns of clinical isolates from patients from various parts of the world [12].

One of the sites included in our list [13], developed by US Centers for Disease Control and Prevention Hospital Control Practice Advisory Committee, is worthy of particular mention because it features guidelines for the protection of health care professionals from infectious agents as well as management of postexposure care. The prevention strategies we found in this website include immunization for vaccine preventable diseases (tetanus, hepatitis B, and influenza) and isolation precautions to prevent exposure to infectious agents. Specific recommendations regarding management of health care workers who have suffered significant exposure to human immunodeficiency virus, hepatitis B and C viruses, *Neisseria meningitidis*, and *Mycobacterium tuberculosis* are also provided in this site.

We considered free access to be a prerequisite for websites to be included in our list, because the rationale of this work and of the world wide web in general is to provide information to all who are interested. In addition, need for free distribution of medical literature is widely supported, and open access journals are expected to enjoy greater increases in impact factor than are their subscription counterparts [14]. However, given that appropriate educational resources are often costly, we acknowledge that the exclusion of websites requiring paid registration might have directed our list of websites toward lower quality resources.

Although we endeavored, through our gathering strategy, to review most websites that provide information on infection control, we also recognize that some sites that offer valuable information on this issue might have been omitted. In addition, there are other potentially relevant sites that we omitted because they did not fulfil the inclusion criteria. The selection criteria were primarily aimed at avoiding the creation of an extended and impractical list, which would be of limited use to a health care worker with time constraints.

Conclusion

We provide the reader with an organized and practical list of available internet resources that contain free and accurate information on prevention and control of NIs. Given the well documented impact of such infections on morbidity and

mortality, as well as the effectiveness of infection control programs, we believe that this work may help to limit NIs through broader distribution of knowledge on infection control measures.

Competing interests

The authors declare that they have no competing interests.

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