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Best of the web in pathology: a practical guide to finding specific pathology resources on the internet

J Boehm

Correspondence to:
Dr Joachim Boehm, Department
of Pathology (Ludwig-Aschoff-
Haus), University Hospital
Freiburg, Postfach 214, D-79002
Freiburg im Breisgau, Germany;
[joachim.boehm@uniklinik-
freiburg.de](mailto:joachim.boehm@uniklinik-
freiburg.de)

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ABSTRACT

Background: Although a large number of pathology-specific websites (PSWs) are accessible on the internet, the potential use of PSWs is relatively unknown among pathologists. As a PSW-directory does not exist, it may be difficult to find certain resources that are scattered over the internet.

Aims: To critically revisit PSWs in order to create a collection of selected websites that may be useful for practising pathologists worldwide.

Methods: Using special medical databases and link collections, extensive search for PSWs was performed on the world wide web. Each website was evaluated with regard to content and practical use for pathologists.

Results: PSWs contain electronic training manuals, journals, case collections, photo-archives, link directories, or slide collections of virtual microscopy. PSWs offer lavishly illustrated education material for undergraduates and postgraduates in pathology, but may also be very useful as reference books or as an instrument of continuing medical education for experienced pathologists. The paper shows how to find PSWs, and presents an annotated list of 100 of the best PSWs.

Conclusions: PSWs as a whole form a heterogeneous patchwork of information. It is suggested that a central catalogue listing all PSWs that are available worldwide be established. This database would enable pathologists to have immediate access to all up-to-date pathology-specific resources on the internet, without the need to perform any laborious web research for themselves. It is hoped that in the future, the repertoire of on-line resources in pathology will be systematically perfected. The internet will then play a central role in the daily practice of pathologists as a medium of information and communication.

The internet and its graphic form, the world wide web (www) (see Sharpened.net¹ for an explanation of this and other computer terms used in the paper) represent a global information network that is expanding rapidly. The effects of the increasing presence of the internet on daily life can also be felt in pathology, as the keywords “digital pathology” and “virtual microscopy” suggest.² Web-based resources may mediate medical information, especially in morphologically and visually oriented disciplines like pathology. The internet is becoming a more and more important source of pathology-specific information, not only for medical students and postgraduates: it also serves as a tool for continuing medical education and as reference book for experienced pathologists.³ However, the potential of the internet as a source of information in pathology remains untapped because pathology-specific online media are still relatively unknown.

The internet, CD-ROMs and DVDs form the so-called “new media”.⁴ Multimediality is one important advantage of these digital media, because different information carriers, namely text, pictures, sound, video, and animations may be combined.⁵⁻⁷ The spectrum of digital media in pathology mainly consists of e-books, e-journals, pictorial atlases, case collections, virtual microscopy slides, video clips, and quizzes.^{3 4 7 8-12} In contrast to paper-based media, digital media can easily be updated and lavishly illustrated, especially by means of coloured pictures.^{3 4} Digital resources are available at any time, from anywhere, and can be linked to further online sources of information. Users may contact website authors for questions by email.

In this study, we aim to draw the readership’s attention to the potentials of web-based resources in pathology and encourage its use by providing a practical collection of pathology-specific websites.

METHODS

From January to March 2007, extensive searches for online resources in pathology were performed using different starting points:

- ▶ common search engines,
- ▶ special medical databases,
- ▶ link collections,
- ▶ email consultations of authors of relevant literature.

RESULTS

In medicine, a multitude of websites exist that differ by content, layout, and target groups. This is especially true for pathology due to its broad range of subspecialties and considerable overlapping with clinical disciplines. There is no central catalogue that clearly lists and continuously updates all the existing pathology-specific websites (PSWs). In this paper we show the paths by which pathologists can find access to pathology-specific information on the internet.

Common search engines

The search for a distinct keyword on the internet can be performed by renowned standard search engines such as “Google”,¹³ “AltaVista”,¹⁴ or “Yahoo!”.¹⁵ For PSWs, however, this starting point cannot be recommended, since this results in a return of thousands of mostly unspecific hits (table 1). It remains a business secret how most of these search engines choose and rank their hits. However, using Google’s topic-related search function “Google Directory”,¹⁶ 43 “pathology” websites were selected, only 27 of which were PSWs in

Table 1 Online search for keywords using standard search engines: number of hits

Keywords*	Google	AltaVista	Yahoo!
Pathology + Website	1 350 000	3 440 000	3 450 000
Pathology + Online Information	3 870 000	4 110 000	4 130 000
Websites for pathologists	1 140 000	118 000	118 000

* Combination of the two keywords "Pathology" and "Website" or "Online Information", respectively (accessed 9 April 2007).

a narrower sense (accessed March 2007). In most cases, these PSWs were link collections as described below.

Special medical databases

There are interdisciplinary medical online databases that assist in finding PSWs. These tools collect and assess medical internet resources in order to make them transparent to seekers for information.¹⁷ The database "KELDAmEd" of the University of Mannheim/Heidelberg (Germany)¹⁸ is available in English and German. In the categories of pathology, cytology, and neuropathology, "KELDAmEd" lists 42 websites, 32 of which are in English. The PSWs are displayed clearly and each resource is provided with a short comment.

The directory "LRSMed" of the University of Essen (Germany)¹⁹ contains 102 entries in the fields of pathology, histopathology, and cytology. The higher number of entries results from the fact that this collection also includes websites with a commercial background, with only marginal relation to pathology, or merely clinical websites. Unfortunately, no annotations are given. The online resources are described only by title, language, and character of the medium (eg pictorial atlas or lecture notes). As there is no information about the contents of the resources listed, pathologists searching for certain PSWs will be confronted with a large number of irrelevant websites.

The internet directory of the British "Intute" database²⁰ is very extensive and contains 114 759 web entries concerning research and education in various life sciences. Within the category "medicine", a search for the keyword "pathology" produced 143 returns, which are all briefly annotated. However, among these resources, only 52 can be regarded as PSWs in the narrowest sense; all are located in the subdivisions "learning materials", "images", and "e-books". On analysis, it becomes evident that the core group of 52 PSWs of the "Intute" database mostly corresponds to the English entries of the "KELDAmEd" database. However, the "Intute" directory also includes a couple of websites that do not belong to pathology, but to radiology.

Using these databases, a substantial part of the pool of web-based resources in pathology can be retrieved. Among these, we consider the database "KELDAmEd" to be the most effective.

Link collections

Another starting point for the detection of PSWs is the link collections that can be found on the websites of medical societies (eg the "European Society of Pathology"²¹), universities or departments of pathology (eg the Karolinska Institute in Stockholm²²), and internet-enthusiastic pathologists (eg Dr Friedlander's "PathGuy"²³).

As a result of our checking numerous link collections, the following aspects have become evident:

- ▶ Link collections may help to find the more common PSWs on the internet. On the other hand, it may be time consuming and laborious to detect less well known

websites, in order to compare various PSWs or to create a link collection oneself.

- ▶ Link collections may be designed to be user-friendly by providing the link with a brief annotation that indicates the contents of the linked website. Having this information a priori, users will avoid clicking on irrelevant internet resources.

Link collections rapidly become obsolete if they are not regularly updated. If the address (URL) of a linked website changes, the contents of the "moved" website will usually no longer be displayed by clicking on the obsolete URL; they will be replaced by "The page you requested could not be found".

Email consultations of authors of relevant literature

In order to obtain more personal information about possible PSWs from experts, we studied the literature and consulted corresponding authors of relevant literature²⁴⁻³³ by email. A total of 18 authors were asked, 11 of whom responded. Table 2 shows the results of the enquiry.

DISCUSSION

We studied the 210 PSWs found by us on the internet. Among these PSWs, some had a password-protected access, which means that users have to register before logging in. Evaluation of the PSWs was performed by following the five criteria described by Talmon *et al*,³⁴ which are more or less subjective:

- ▶ Accuracy: Does the information given on the website correspond to the state of medical knowledge?
- ▶ Ease of navigation: Are texts and graphics easy to understand? Are different elements of the website arranged logically?
- ▶ Relevance: Are the website contents useful for practising pathologists?
- ▶ Updates: When did the last modification of the website take place?
- ▶ Completeness: What is the depth of the website information? Are there only keywords or are there detailed facts, supported by references?

In contrast to Talmon *et al*,³⁴ we did not score these criteria because this was not practicable in the face of a total of 210 websites under investigation. However, we placed great emphasis on quality and pathology-relevance of the pictures shown on the PSWs. After evaluation, we selected 100 of these 210 websites that we considered to be outstanding to form a collection of PSWs useful for practicing pathologists (table 3). The PSWs in table 3 were grouped according to the different subspecialties of pathology (eg gynaecological or cytological pathology) or with regard to common features (eg link collections or virtual slides). Each of the selected PSWs was provided with a brief annotation to point to its characteristics. Another criterion for the inclusion of certain PSWs in table 3 was their respective content: PSWs with a special topic, such as virtual autopsies, were preferentially selected. Thus, a broad spectrum of different PSW contents have merged in table 3. We do not claim that table 3 includes *all* of the most relevant PSWs, but we believe that the majority of important pathology-related websites can be found in the table. We consider this PSW collection to be a useful tool for pathologists to access the online resources of pathology easily.

The website studies of Talmon *et al*³⁴ represent the only comparable collection of PSWs in the literature. The authors evaluated some 50 websites from a wider field of pathology using their own scoring system and listed the resulting top 35 in

Table 2 Website recommendations given by consulted authors

No.	Author	Recommended PSWs
1	Anderson, PG [Alabama, USA] ³	WebPath: http://library.med.utah.edu/WebPath/webpath.html
2	Dee, FR [Iowa, USA] ²⁵	Virtual Slidebox: http://www.path.uiowa.edu/virtualslidebox/
3	Epstein, JI [Baltimore, USA] ²⁶	3.1. Johns Hopkins Pathology: http://pathology2.jhu.edu/sp/ 3.2. ISUP*: http://pathology2.jhu.edu/isup/index.cfm
4	Glatz-Krieger, K [Basel, SUI] ²⁷	4.1. PathMax: http://www.pathmax.com/main.html 4.2. WebPath: → see 1. 4.3. PEIR Digital Library: http://peir.net/ 4.4. Case Index Pittsburgh: http://path.upmc.edu/cases/index.html 4.5. Johns Hopkins Pathology: → see 3.1. 4.6. Pathologie-Online: http://www.pathologie-online.de/ (in German)
5	Krippendorf, BB [Wisconsin, USA] ²⁸	None
6	Kumar, R [Sydney, AUS] ²⁹	5.1. Museum of Human Disease: http://web.med.unsw.edu.au/pathmus/ 5.2. WebPath: → see 1. 5.3. PEIR Digital Library: → see 4.3. 5.4. PathGuy: http://www.pathguy.com/lectures.htm 5.5. Seattle: http://www.pathology.washington.edu/about/education/gallery/ 5.6. ASH: http://www.ashimagebank.org/collections/
7	Lam, AKY [Townsville, AUS] ³⁰	WebPath: → see 1.
8	Marchevsky, AM [Los Angeles, USA] ³¹	7.1. AFIP: https://tele11.afip.org/onlineservices/pg_online_services.pc_main† 7.2. USCAP: http://www.uscap.org 7.3. Long Island: http://www.liu.edu/CWIS/CWP/LIBRARY/ref/hsmb705.htm 7.4. WebPath: → see 1.
9	Reid, WA [Edinburgh, UK] ³²	8.1: PathMax: → see 4.1. 8.2: HemePath: http://pleiad.umdj.edu/~dweiss/index.html 8.3.: PathCAL: https://www.eros.mvm.ed.ac.uk/pathcal.asp‡
10	Siegal, GP [Alabama, USA] ³	Medscape: http://www.medscape.com/pathology
11	Velan, GM [Sydney, AUS] ^{29, 33}	10.1. WebPath: → see 1. 10.2. Virtual Slidebox: → see 2. 10.3. Pathweb: http://pathweb.uchc.edu/ 10.4. Case Index Pittsburgh: → see 4.4. 10.5. SUNY Cytotechnology: http://www.upstate.edu/courseware/cytotech/ 10.6. CytologyStuff: http://www.cytologystuff.com/start.htm

We take no responsibility for the content of the websites listed above.

*International Society of Urological Pathology [requires membership to the International Society of Urological Pathology].

†No access on 11 April 2007.

‡Requires User ID and Password from the authors.

a table. More than two years after the Talmon *et al* paper was accepted for publication, 31 of the 35 PSWs are still accessible (access: April 2007). Two further links have a new address, but are still easily accessible due to automatic rerouting. Four links are, however, no longer accessible (forming so-called “dead links”). These findings indicate that such link collections have to be updated within a period of two years otherwise they will become obsolete.

The search for PSWs has shown that the spectrum of resources available on the internet represents a patchwork

composed of very different individual parts that do not form an integrated whole. The reason is that on the one hand, online pictures of pathological findings in general are numerous, but on the other hand, there are hardly any resources, for example dealing with the diagnosis of lymphomas.

One major problem of the internet is the complexity of its website structures so that in the face of the multitude of the given information users may become confused. In many cases one may rapidly gain some insight in a certain matter but not an overview. This reminds us of the proverb “not to see the forest for the trees”, which may apply to internet searches.

Almost each website has an individual design. Therefore, users first have to orientate themselves with respect to navigation paths by which information and files may be accessible. Well structured, up-to-date, highly informative PSWs are rare and can be found mostly on the websites of elite universities or governmental organisations in the USA. On the other hand, insufficient quality of the pictorial material, missing updates or incompleteness of contents are serious shortcomings of numerous PSWs.

The authors of most PSWs do not mention the date of the last update or for which target group the website was made. In most cases the website contents are suitable for both pathologists and medical students. One should also consider that patients may have access to the websites. This is one of the reasons why we suggest that PSWs, or even better all medical



Figure 1 The HON code seal of the “Health On The Net (HON) Foundation”.

Table 3 Selection of 100 useful pathology-specific websites, arranged in alphabetical order

No.	Website	URL	Last update	Comment
Generalists				
1	Best of the web "Knowledge Hub" [USCAP: US and Canadian Academy of Pathology]	http://www.uscap.org/	*	Handouts and course material of all subdisciplines of pathology (some 50 000 pages of the USCAP meetings of the last 5 years)
2	PathMax [Dr Cowper, Yale U, USA]	http://www.pathmax.com/main.html	(2006)	Huge database with >3400 links from all fields of pathology (but: links without annotations, numerous duplicates)
3	Patho Basiliensis [U Basel, SUJ]	http://pages.unibas.ch/patho/	*	Extensive material: 9331 annotated pictures (macro/micro), 168 cytology and 118 autopsy cases, microscopic courses, VM → no. 30, search functions
4	PathPics [Columbia U, USA]	http://cpmcnet.columbia.edu/dept/curric-pathology/pathology/pathology/pathoatlas/index.html	*	Extensive, interactive, and annotated pictorial atlas (macro/micro)
5	Pathweb [U Connecticut, USA]	http://pathweb.uconn.edu/	(2005)	Annotated pictorial atlas of systemic pathology, search functions
6	PER.net : Pathology Education Instructional Resource [U Alabama, USA]	http://per.path.uab.edu/	*	Pictorial database (n = 34 000: macro/micro), link collections
7	WebPath [U Utah, USA]	http://library.med.utah.edu/WebPath/webpath.html	(2007)	Broad range of material: excellent pictures (n = 1900) with annotations, tutorials, quizzes
Case collections				
8	Anatomic Pathology Teaching Cases [Oklahoma U, USA]	http://moon.ouhsc.edu/ktung/JTY1/Com/index.htm	3/07	Collection of 93 cases, among them 53 neuropathology cases
9	Clinico-Pathological Conference [Johns Hopkins U, USA]	http://oac.med.jhu.edu/cpc/links.cfm	9/06	Discussion of 42 CPC cases
10	Indiana Clinical Cases [Indiana U, USA]	http://medsci.indiana.edu/c602web/602/c602web/toc.htm	(2005)	Discussion of 220 microscopic slides and 26 CPC cases
11	Online Case Studies [U Pittsburgh, USA]	http://path.upmc.edu/cases/index.html	(2005)	Discussion of 504 cases of clinical and anatomic pathology
12	Online Conferences and Tutorials [Johns Hopkins U, USA]	http://pathology.jhu.edu/department/teaching.cfm	(2007)	JHU Educational Homepage (→ see nos 17, 22, 43, 71, 83)
13	Surgical Pathology Unknown Conference [Johns Hopkins U, USA]	http://pathology2.jhu.edu/sp/	3/07	Discussion of 6–8 case studies per week since 8/00
14	V543 General Pathology [U Indiana, USA]	http://www.opt.indiana.edu/v543/slides/index.html	9/05	Slide collection of 35 cases, partially including virtual slides, "Online Laboratories": → lecture of general pathology
Information portals				
15	Humpath.com [Montréal, CDN]	http://www.humpath.org/	3/07	Extensive pictorial database (n = 1300) with keyword catalogue (but: long loading time of pictures)
16	PathCentral [Sheffield, UK]	http://www.pathcentral.org.uk/	10/06	Central link page for histopathologists in the UK
17	PathologyOutlines.com [Michigan, USA]	http://www.pathologyoutlines.com/	10/06	Extensive information portal with catalogue of keywords, links, and 77 case studies
Link collections				
18	Biomedical links [Karolinska Institutet, U Stockholm, SWE]	http://www.mic.ki.se/MEDIMAGES.html	6/06	Collection of links leading to case collections and pictorial material in medicine → category: "Pathology"
19	Clinical Laboratory Science Internet Resources [Texas U, USA]	http://members.tripod.com/~LouCaru/index-5.html	2/07	Huge link collection of clinical pathology
20	Educational Links [Walter Reed Army Medical Center, Washington, USA]	http://www.wramc.amedd.army.mil/departments/pathology/educatlink.htm	8/04	Huge, well arranged link collection of pathology and neighbouring medical disciplines
21	MedWeb [Emory U, Atlanta, USA]	http://www.medweb.emory.edu/MedWeb/	(2004)	Catalogue of links: 507 alphabetically sorted links: "Specialties" → "Pathology and Laboratory Medicine"
22	PathGuy [Kansas, USA]	http://www.pathguy.com/lectures.htm	*	Unorthodox link collection of Dr Friedlander, special on autopsies
Picture databases				
23	Case Studies in Pathology [Indiana, USA]	http://medsci.indiana.edu/c602web/602/c602web/toc.htm	(2001)	Microscopic course of 223 slides with annotated pictures and VM), 26 clinical cases and quizzes
24	Histopathology-India [Dr Roy, Calcutta, India]	http://www.histopathology-india.net/intro.htm	11/06	Ambitious website containing extensive material about skin, lung, and GI tract. 100 diagnostic cases
25	Histopathology Website [McGill U, Montréal, Canada]	http://sprojects.mmi.mcgill.ca/histopathology/index.htm	*	Microscopic course containing 100 slides with annotated pictures

Continued

Table 3 Continued

26	IPLAB: Interactive Pathology Laboratory [USA]	http://peir.path.uab.edu/plab/	*	Part of no. 8, 100 cases of general pathology, well illustrated, useful links
27	Museum of Human Disease [Sydney, AUS]	http://www.hematologyatlas.com/principipalpage.htm	2/07	Discussion of 33 cases on the basis of macroscopic pictures using interactive features
28	Pathology Images [Dr Uthman, Houston, USA]	http://www.geocities.com/hotsprings/falls/7780/index.html	1/02	31 diagnoses at the basis of macroscopic pictures (mostly: gynaecologic, GI-tract, head & neck)
29	PERLJam: Pathology Education Resources Lab [U Indiana, USA]	http://erf.pathology.iupui.edu/INDEX.HTM	(1998)	Pictorial atlas of general and systemic pathology & histology (but: quality of macroscopic pictures often mediocre)
30	Tapir: Teaching archive of pathology image resources [U Cambridge, UK]	http://tapir.caret.cam.ac.uk/	(2005)	Database containing 3798 pictures with annotations (macro/micro)
31	Urbana Atlas of Pathology [U Illinois, USA]	http://www.med.uiuc.edu/pathatlas/titlepage.html	(1997)	Pictorial atlas of general and systemic pathology with brief annotations (but: quality of pictures mediocre)
32	Virtual microscopy		*	178 virtual slides of systemic pathology
33	Virtual Microscopy [UC Davis U California, USA]	http://sommmedia.ucdavis.edu/slides/	10/06	609 virtual slides of human pathology
34	Virtual Slidebox [U Iowa, USA]	http://www.path.uiowa.edu/virtualslidebox/	*	173 virtual slides with brief comments
35	vMIC [U Basel, SUJ]	http://vmic.unibas.ch/	1/06	Atlas of breast pathology (150 virtual slides), slide seminars, virtual double stainings
36	Web Microscope [U Tampere/ Helsinki, FIN]	http://www2.primed.helsinki.fi/		
	Special disciplines			
	Cytopathological pathology			
36	Bethesda System Website Atlas [USA]	http://www.cytopathology.org/NIH/index.php	9/03	Cytology atlas with 349 pictures illustrating the Bethesda System of 2001
37	Cytology Stuff [Cytoc Corporation, Marlborough, USA]	http://www.cytologystuff.com/start.htm	*	Atlas and case collections of gynaecological and non-gynaecological cytology
38	Cytopathology Tutorial [Johns Hopkins U, USA]	http://pathology2.jhu.edu/cyto_tutorial/index.cfm	6/02	Atlas (701 pictures) and tutorial (28 case studies) on all fields of cytology
39	Cyrotechnology Website [SUNY, New York, USA]	http://www.upstate.edu/courseware/cyrotech/	5/02	Cytology atlas of lung and infections
40	Die große bunte Welt der Zytologie [TU Munich, GER]	http://www.zytologie.de/	9/05	Picture collection and e-learning material from all fields of cytology, papers (German, also in English)
41	Dr Prollas Cytopathology Atlas [Porto Alegre, Brazil]	http://www.geocities.com/jcprolla/jcprolla.html	3/07	128 sumptuously illustrated "Cases of the month", mostly non-gynaecological
42	Interesting Case Conference [Johns Hopkins U, USA]	http://pathology2.jhu.edu/cytopath/welcome.cfm	2/07	Discussion of cases of 95 conferences, each with 4 cases (including all fields of cytology)
43	Norwegian Society of Clinical Cytology		7/04	Technology of fine-needle aspiration biopsy, tutorial on cytology of the salivary glands, 38 cases including histopathological findings
44	UT-Cytopathology [U Texas, USA]	http://129.240.38.9/horcyf/index4.html	7/05	250 pictures and 6 cases of gynaecological and non-gynaecological cytology (but: pictures often sparsely annotated)
45	Dermatological pathology		1/06	Dermatology atlas (3648 clinical and microscopic pictures), interactive features, some virtual slides
46	Atlas of Dermatology [U Brno, CZ/ U Zurich, SUJ]	http://atlases.muni.cz/atf_en/sect_main.html	1/04	Link collection of dermatology and pathology of the skin
47	Dermatology Databases [U Iowa, USA]	http://tray.dermatology.uiowa.edu/DermDB.htm#DermPath	1/04	278 diagnoses on the basis of case reports (→ "Archives")
48	Dermatopathology by Weems [Utah, USA]	http://www.bweems.com/		
49	ENT-pathology		*/04	Pictorial atlas of lesions of the oral cavity
50	Oral Pathology [U Southern California, USA]	http://www.usc.edu/hsc/dental/optf/index.html	3/99	Illustrated lecture notes for students of dentistry
51	Oral Pathology "Web Course" [U Southern California, USA]	http://www.usc.edu/hsc/dental/opath/index.html		
52	Gastrointestinal pathology		12/06	42 conference cases of lesions in the GI tract
53	GI/Liver Case Conference [Johns Hopkins U, USA]	http://pathology2.jhu.edu/gicases/	*	Collection of annotated pictures about the pathology of the GI tract
54	GI Pathology Images [Tulane U, New Orleans, USA]	http://www.som.tulane.edu/classware/pathology/medical_pathology/McPath/GICD/default.html		
55	Pancreas Cancer Web [Johns Hopkins U, USA]	http://pathology.jhu.edu/pancreas/	*/07	Information pages for doctors and patients about pancreatic carcinomas, including microscopic pictures

Continued

Table 3 Continued

53	University Pathologists [Boston U, USA]	http://www.xcellpath.com/	*/07	15 tutorials and 1302 annotated pictures about the pathology of the GI tract, 5 "Cases of the month"
54	Gynaecological pathology Breast Pathology on the Web [Dr Thomas, Edinburgh, UK]	http://www.breastpathology.info/index.html	3/07	Practice-oriented lecture notes on breast pathology including pictures of excellent quality, 1 case per month, slideboxes
55	Endometrium.org [Dr Mutter, Brigham, Boston, USA]	http://www.endometrium.org/	(2007)	Illustrated tutorial and literature about carcinomas of the endometrium and its precursors
56	Haematological pathology ASH Image Bank: American Society of Hematology [USA]	http://www.ashimagebank.org/collections/	*/07	501 sets of pictures with annotations
57	Atlas of Hematology [Dr Medeiros, Albany, USA]	http://www.hematologyatlas.com/principalpage.htm	*	Extensive pictorial atlas of haematology, including parasites and fungi
58	BloodLine Image Atlas [USA]	http://image.bloodline.net/	*/07	>800 blood and bone marrow smears, without NHL
59	HemePath Tutorial [U New Jersey, USA]	http://pleiad.umdnj.edu/~dweiss/index.html	5/06	Tutorial on lymphomas in lymph nodes
60	Hepatic pathology Review of Pathology of the Liver [Loyola U, USA]	http://www.meddean.luc.edu/lumen/MedEd/orfpath/pathftrtl.htm	*	Lavishly illustrated lecture notes on non-tumorous hepatopathies
61	Nephrological pathology Atlas of Renal Pathology [Vanderbilt U, USA]	http://www2.us.elsevierhealth.com/ajkd/atlas/38/6/atlas38_6.htm	(2001)	Annotated pictorial atlas of renal pathology, associated with the <i>American Journal of Kidney Diseases</i>
62	Renal Pathology Tutorial [U North Carolina, USA]	http://www.gamewood.net/rnet/renalpathy/tutorial.htm	(2007)	Tutorial on glomerulopathies including 6 case studies
63	Neurological pathology Introduction to Neuropathology [SUNY, New York, USA]	http://www.path.sunysb.edu/faculty/woz/NPERESS/webclasstitle.htm	*/97	Lecture notes on neuropathology including 100 pictures
64	Neuromuscular Disease Center [U St Louis, USA]	http://www.neuro.wustl.edu/neuromuscular/index.html	3/07	Portal to neuromuscular diseases including an atlas with annotations
65	Online Neuropathology Atlas [U Debrecen, HUN]	http://www.neuropat.dote.hu/atlas.html	2/03	Atlas of neuropathology (macro/micro), links (but: hardly any picture legends)
66	Stereotactic Biopsy Diagnosis of Intracerebral Lesions [U Homburg, GER]	http://www.med-rz.uni-sb.de/med_fak/neuropatho/sbdl/index.html	2/01	Tutorial on diagnostic stereotactic biopsies including 12 cases
67	Ophthalmic pathology Ophthalmic Pathology Atlas [U Wisconsin, USA]	http://wiewemd.ophth.wisc.edu/ocupath/main.html	*	Annotated interactive atlas of lesions of the eyes
68	The EyePathologist [Duke U North Carolina, USA]	http://www.eyepathologist.com	(2002)	Annotated atlas of anatomy and pathology of the eyes with >3900 pictures
69	Orthopaedic pathology Bone Tumors [New Jersey U, USA]	http://www.umdnj.edu/tutorweb/	2/04	Tutorial for residents: introductory course, 20 case reports
70	Orthopedic Pathology Review [Washington, USA]	http://www.sarcoma.org/main.php?page=review	10/02	Course material on pathology of bones and soft tissue with correlation to radiology/MRI
71	Paediatric pathology Diseases and Disorders [Karolinska Institutet, U Stockholm, SWE]	http://www.mic.ki.se/Diseases/C16.html#C16.131.260.800.490	3/07	Collection of links to congenital and hereditary disorders
72	Geneva Foundation for Medical Education and Research [Geneva, SWI]	http://www.gfmer.ch/genetic_diseases_v2/index.php	3/07	Pictorial databases about developmental disorders and genetic caused diseases
73	Virtual Pediatric Hospital [U Iowa, USA]	http://www.virtualpediatrichospital.org/providers/CAP/CAPHome.shtml	7/06	Interdisciplinary discussion of 56 cases including radiology, surgery, and pathology
74	Pathogen-induced pathology Atlas of Granulomatous Diseases [Dr Rosen, USA]	http://www.granuloma.homestead.com/index.html	*	Special on granulomatous disorders
75	Microbiology and Immunology On-line [U South Carolina, USA]	http://pathmicro.med.sc.edu/book/welcome.htm	3/07	Extensive and illustrated e-book, lectures (ppt slides) on microbiology and immunology
76	Parasite Image Library [U Atlanta, USA]	http://www.dpd.cdc.gov/dpdx/default.htm	5/05	Methods, pathogens, and pictorial atlas with annotations in parasitology
77	Visceral Leishmaniasis [Dr Medeiros, Albany, USA]	http://www.geocities.com/donovani/	*	Small illustrated tutorial on leishmaniasis in the bone marrow
	Pulmonary pathology			

Continued

Table 3 Continued

78	Practical Pathology of Chest Disease [U California, USA]	http://pathhisw5m54.ucsf.edu/introduction.html	6/01	Illustrated lecture notes and 35 cases of lung pathology, correlation radiology/pathology with 22 cases
79	Transplantation pathology Transplant Pathology Internet Services [U Pittsburgh, USA]	http://tpis.upmc.edu/	9/05	Forum and information portal to the topics transplantation and rejection, including case conferences (for all kinds of transplanted organs)
80	Urological pathology Gleason Grading of Prostatic Carcinoma [Johns Hopkins U, USA]	1. http://pathology2.jhu.edu/gleason/index.cfm 2. http://162.129.103.34/prostate/ http://www.webpathology.com/index.cfm http://pathology.jhu.edu/bladder/	(2004)	Illustrated tutorial on Gleason grading of prostatic carcinoma
81	WebPathology.com [Virginia, USA]	http://www.webpathology.com/index.cfm	1/05	601 microscopic pictures about lesions of the urogenital organs
82	WHO/ISUP Classification of Urothelial Neoplasms [U Johns Hopkins, USA]	http://pathology.jhu.edu/bladder/	10/06	Sumptuously illustrated tutorial on urothelial tumours
	Supplementary sites			
	Life sciences			
83	Atlas of Genetics and Cytogenetics in Oncology and Haematology [U Poitiers, FRA]	http://atlasgeneticsoncology.org/index.html	3/07	Portal to oncological cytogenetics with encyclopaedia and case reports
84	EBI: European Bioinformatics Institute [Cambridge, UK]	http://www.ebi.ac.uk/	(2007)	European portal to bioinformatics
85	ExpASY [SU]	http://www.expasy.org/	1/07	Databases and links to proteomics
86	Genetics Home Reference [National Library of Medicine, USA]	http://ghr.nlm.nih.gov/	3/07	Detailed information about human genetics and its disorders (including handbook and glossary)
87	genomics.energy.gov [USA]	http://genomics.energy.gov/	*	Portal to gene research in the USA, including the Human Genome Project
88	NCBI: National Center for Biotechnology Information [Bethesda, USA]	http://www.ncbi.nlm.nih.gov/	3/07	Portal to molecular biology
89	OMIM: Online Mendelian Inheritance in Man [Johns Hopkins U, USA]	http://www.ncbi.nlm.nih.gov/entrez/query.fcgi?db=OMIM	*	Catalogue of human genes and their disorders
	Others			
90	Health On the Net Foundation [Geneva, SU]	http://www.hon.ch/index.html	1/07	Swiss foundation, quality scout for medical websites
91	Hoslink [AUS]	http://www.hoslink.com/phome.htm	*	Collection of links in pathology, correlation of findings in pathology with laboratory parameters
92	RadPath [BrighamRAD, Boston, USA]	http://brighamrad.harvard.edu/Cases/bwrh/hcache/group0-index.html	*	Correlations of findings in radiology/pathology on the basis of a collection of 70 cases
	Special methods			
93	Department of Frozen Section [Fürth, GER]	http://www.pathologie-fuerth.de/	5/06	Methods and practice of frozen sections, discussion of 34 cases
94	Immunohistochemistry vade mecum [Dr Bishop, Manchester, UK]	http://www.e-immunohistochemistry.info/	1/07	Guide to diagnostic immunohistochemistry
95	ImmunoQuery [Dr Frisman, Eisenhower Med. Center, USA]	http://www.ipox.org/login.cfm?IDMessage=2	1/07	Immunohistochemical marker profile of tumours
96	Nordic immunohistochemical Quality Control [Scandinavia]	http://www.nordiqc.org/	3/07	Information about immunohistochemistry. Collection of links
97	RCPA-Manual: Royal College of Pathologists of Australasia [AUS]	http://www.rcpamanual.edu.au/	3/04	Guidelines for the use of pathology tests and interpretation of results
98	Society for Ultrastructural Pathology [USA]	http://sup.ultrakoil.com/	2/07	Portal to electron microscopy. Case studies (from the years 1996–99)
99	The JCSMR Flow Cytometry Laboratory [Canberra, AUS]	http://jcsmr.anu.edu.au/facslab/facshome.html	12/01	Portal to flow cytometry
100	The Virtual Autopsy [Leicester, UK]	http://www.le.ac.uk/pathology/teach/va/titpag1.html	(2001)	Autopsy case simulations: discussion of 18 cases

We take no responsibility for the content of the websites listed above. All websites accessed March and April 2007.

Column "Last Update": *, not indicated; 3/07, March 2007; */07, 2007, month not indicated; (2006), last update not indicated, but (as a replacement) year of last copyright.

U, university; macro/micro, macroscopic & microscopic; VM, virtual microscopy; →, go to; CPC, clinicopathological conference; GI, gastrointestinal; NHL, non-Hodgkin lymphoma; MRI, magnetic resonance imaging; ppt, Powerpoint.

Take-home messages

- ▶ The internet has a large number of pathology-specific websites (PSWs), which form a heterogeneous patchwork that is far from being perfect.
- ▶ Although these web-based resources may be useful for daily work, they are relatively unknown among pathologists.
- ▶ In practice, it may be difficult to find certain online resources scattered over the internet, since a global PSW directory is not available.
- ▶ In order to facilitate access to online media for pathologists, an annotated list of 100 selected PSWs is presented here, which may serve as a starting point for further studies.
- ▶ For immediate access to the resources on the internet, establishment of a central catalogue listing and annotating all PSWs available worldwide is suggested.

websites, should fulfil universally applicable quality standards before they are allowed to be displayed on the internet. There is no mandatory quality control for medical website contents. Many sites provide valuable information, while others have data that are unreliable or misleading.³⁵ The “Health On The Net (HON) Foundation”, situated in Geneva, scientifically evaluates medical websites with regard to their quality standards, and awards a seal of quality (fig 1).³⁶ In April 2006, the HON code logo had been used by more than 5000 accredited medical websites. Special guidelines were defined in a catalogue that should help authors to improve quality while creating digital media in medicine.³⁷

Analogous to the situation of e-learning,³⁸ PSWs will in future not replace but complement the traditional resources in pathology, as do, for example, textbooks or tutorials. The most serious changes that pathology will have to face under the increasing influence of the internet are supposed to result from the potential of virtual microscopy.⁹ It will be interesting to see what appearance pathology as a medical discipline will have in a fully digitised future.

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