

*Full Length Research Paper*

# Sharing information and internet resources of immunological interest

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Human genome project produce vast quantities of data with new sequences being added to Deoxy ribonucleic acid (DNA) databases on an average of once a minute. It is expected that over 1,000 genome will be sequenced within the next 5 to 10 years. Internet access has turned into an important part of any biological study. The extensive range of information available on the internet can save individual researcher time and energy. Detailed genomic map, abstracts, research paper and many large public databases are reachable in real time through internet. Internet is a highly useful information source as well as electronic highway to accomplish up to date knowledge in the field of research. Although multitude of data is available, research community may face insurmountable obstacle while searching information about his research work. This article is platform to assist the immunologist or biologist to get information at glance.

**Key words:** Databases, Internet, Immunology, web resources, data mining.

## INTRODUCTION

A large extent of work on immunology has been completed in laboratory worldwide and now this is the era of accessing the internet. Information pools on the internet have been influential in transformation of working mode of researchers and technologies to search and exchange information amongst themselves and with business clients or end users (Sharma et al., 1999). The focused data which at one time was communicated only through paper is now digitized and available from centralized databases. Journals are now published online. The well-known research community has web pages offering everything from reprint to software downloads and automated data processing services, but efficiently, finding of information on the web is a skill which requires the knowledge of surfing, specifically for useful scientific articles, softwares, databases and technique to use the classic online information (Sharma and Dwivedi, 2002a).

This paper is an overview of sourcing information on web, with some pointers on how to judge the quality of information, with the increasing interest as well as awareness worldwide, towards severe diseases such as acquired immunodeficiency syndrome (AIDS), mumps, severe acute respiratory syndrome (SARS), and Japanese encephalitis (JE) viral infection (Sharma et al., 2002b). The expansion in information technology during the 1980 and 1990s have led to an increasing proportion of this pool of information now being held in electronic form in databases which can be accessed online from sites.

Internet is a highly useful information source as well as electronic highway to achieve up to date knowledge in the field of research. Researchers can exchange software data easily through the net and it can also be a kind source of practical advice about computer software and hardware, experimental method and protocols, and laboratory

equipment.

Yahoo, Netscape, AltaVista, Lycos, NET search and several other search engines exist to help find a way around the billion or more pages that make up the web. In order to search successfully, one needs to use Boolean logic. All search engines retrieve the information in the query forms from the public biological databases. Subsequently, this study describes some useful databases. The national and international institutions and organizations of the world related to immunology are listed as shown in Table 1 and essential databases and websites are shown in Table 2.

### **PUBMED**

Pubmed is one of the most precious resources available to the researcher. Over 4000 journals are indexed in pubmed, including most of the well rated journals in immunology, molecular biology and related fields. It is used to search research papers available on internet. There are dozens of biological databases on the web and many alternate web biological databases on the web, and many alternate web interfaces that provides access to the same set of data.

### **NATIONAL CENTER FOR BIOTECHNOLOGY INFORMATION (NCBI; <http://www.ncbi.nlm.nih.gov>)**

This website presents US National Library of Medicine and National Institute of Health. It contains a lot of high quality databases: PubMed/Free Medline, GenBank, UniGene, OMIM, etc.

### **SWISSPROT (<http://Expasy.hchuge.ch/sprot.html>)**

Swissprot is a protein sequence database which from its inception in 1986, was produced collaboratively by the Department of Medical Biochemistry at the University of Geneva and European Molecular Biology Laboratory (EMBL), after 1994, the collaboration moved to EMBLs UK out station European Bioinformatics Institute (EBI) (Bairoch and Apweiler, 1998). In April, 1998 further changes saw a move to the Swiss Institute of Bioinformatics (SIB), hence the database is maintained collaboratively by SIB and EBI/EMBL. The database endeavor to provide high level annotations, including description of the function of the protein and of the structure of its domains, post translational modification, variants, etc. By mid 1998, the database contained 70,000 entries from more the 5,000 different species.

### **OWL ([www.Biochem.ucl.ac.uk/bsm/dbbrowser/owl](http://www.Biochem.ucl.ac.uk/bsm/dbbrowser/owl))**

OWL is a non redundant protein sequence database built at the University of Leeds, in collaboration with the Daresbury Laboratory in Warrington (Bleasby et al.,

1994). The database consists of four major primary sources, for example Swissprot, Protein Information Resource (PIR), Genband and Naval Research Laboratory (NRL).

### **PROSITE (<http://expasy.hchuge.ch/spwt/prosite.html>)**

The first secondary database to have been developed was prosite, now maintained collaboratively at the Swiss Institute of Bioinformatics (Barroch et al., 1998). Within prosite, motif is encoded as regularly expressed, simply referred to as patterns. Searching such database should help to determine to which formulae if proven, a new sequence might belong and which domains (a functional site) it might contain.

### **PIR ([www.nbrfa.georgetown.edu/pir](http://www.nbrfa.georgetown.edu/pir))**

This protein sequence databases was developed by National Biomedical Research for qualities (NBRF) in the early 1960s by Margaret Dayhoff, as collection of sequences for investigating evolutionary relationship among protein. Since 1988, the protein sequence database has been maintained collaboratively by private information retrieval (PIR) (Barker et al., 1998), an association of macromolecular sequence data collection center.

### **MARTINSRIED INSTITUTE FOR PROTEIN SEQUENCES (MIPS; <http://www.mips.biochem>)**

MIPS collects and processes sequence data for the tripartite PIR-International Protein Sequence Databases project (Mewes et al., 1997). The database is distributed with patchx, a supplement of universified protein sequence from external sequences. Access to the databases is provided through its web server.

### **CYTOKINE SIGNALING PATHWAY DATABASE (<http://csp.medic.kumamoto-u.ac.jp>)**

The database contains information on signaling pathways of cytokines. It is designed to be a tool for biomedical researchers who work with cytokines and their receptors, and provides biomedical data and references about signaling molecules as well as ligand-receptor relationships.

### **CYTOKINES (<http://www.copewithcytokines.de>)**

COPE-Cytokines online pathfinder encyclopaedia is a site maintained by Hilbelgauf, who is the author of the Dictionary of Cytokines. It contains hyperlinked entries covering all aspects of cytokine research.

**Table 1.** List of national and international institutes.

<b>Institute and organization</b>	<b>Website</b>
African Malaria Vaccine Testing Network	<a href="http://www.amvtn.org">www.amvtn.org</a>
ILSI Allergy and Immunology Institute	<a href="http://www.ilsa.org/aii.html">www.ilsa.org/aii.html</a>
International Center for Genetic Engineering and Biotechnology	<a href="http://www.icgeb.trieste.it">www.icgeb.trieste.it</a>
International Vaccine Institute	<a href="http://www.ivi.org">www.ivi.org</a>
Institut Pasteur de Dakar	<a href="http://www.ird.sn">www.ird.sn</a>
MRC Laboratories, The Gambia	<a href="http://www.mrc.ac.uk">www.mrc.ac.uk</a>
National Institute for Virology	<a href="http://www.niv.ac.za">www.niv.ac.za</a>
Theodore Bilharz Research Institute (TBRI)	<a href="http://www.sti.sci.eg">www.sti.sci.eg</a>
Uganda Virus Research Institute	<a href="http://www.mrc.ac.uk/inter.html">www.mrc.ac.uk/inter.html</a>
Center for Vaccine Biology and Immunology at the Aab Institute of Biomedical Sciences	<a href="http://www.urmc.rochester.edu/Aab/vaccbio/vacc">www.urmc.rochester.edu/Aab/vaccbio/vacc</a>
Chemical Immunology and Therapeutics Research Center (CITRC)	<a href="http://www.dpalm.med.uth.edu">www.dpalm.med.uth.edu</a>
Department of Immunology, The Scripps Research Institute	<a href="http://www.scripps.edu">www.scripps.edu</a>
Experimental Immunology Branch, National Cancer Institute, NIH	<a href="http://www.rex.nci.nih.gov">www.rex.nci.nih.gov</a>
Gladstone Institute of Virology and Immunology (GIVI)	<a href="http://www.gladstone.ucsf.edu">www.gladstone.ucsf.edu</a>
Harvard AIDS Institute	<a href="http://www.hsph.harvard.edu">www.hsph.harvard.edu</a>
Immunology and Disease Resistance Laboratory at the Livestock and Poultry Sciences Institute	<a href="http://www.ipsi.barc.usda.gov">www.ipsi.barc.usda.gov</a>
Institute for Advanced Studies in Immunology and Aging	<a href="http://www.iasia.org">www.iasia.org</a>
La Jolla Institute for Allergy and Immunology	<a href="http://www.liai.org">www.liai.org</a>
Massachusetts Eye and Ear Infirmary	<a href="http://www.immunology.meei.harvard.edu">www.immunology.meei.harvard.edu</a>
National Jewish Medical and Research Center	<a href="http://www.nic.org">www.nic.org</a>
The Jamaican Sickle Cell Unit	<a href="http://www.mrcjamaica.nimr.ac.uk">www.mrcjamaica.nimr.ac.uk</a>
Institute for Virus Research (IVR)	<a href="http://www.virus.kyoro-u.ac.jp">www.virus.kyoro-u.ac.jp</a>
National Cancer Center, Japan	<a href="http://www.info.ncc.go.jp">www.info.ncc.go.jp</a>
National Institute of Immunology, India	<a href="http://www.nii.res.in">www.nii.res.in</a>
National Institute of Infectious Diseases, Japan	<a href="http://www.nih.go.jp/niid">www.nih.go.jp/niid</a>
Basel Institute of Immunology	<a href="http://www.bii.ch">www.bii.ch</a>
Centre d'Immunologie de Marseille-Luminy	<a href="http://www.ciml.univ-mrc-fr">www.ciml.univ-mrc-fr</a>
Centre d'Immunologie Pierre Fabre	<a href="http://www.cipf.com">www.cipf.com</a>
Institut Pasteur de Lille	<a href="http://www.pasteurs-lille.fr">www.pasteurs-lille.fr</a>
Engelhardt Institute of Molecular Biology	<a href="http://www.imb.ac.ru">www.imb.ac.ru</a>
Edward Jenner Institute for Vaccine Research	<a href="http://www.jenner.ac.uk">www.jenner.ac.uk</a>
Institute of Immunology and Experimental Therapy	<a href="http://www.immuno.iitd.pan.wroc">www.immuno.iitd.pan.wroc</a>
Institute of Transplantation Immunology )	<a href="http://www.med.uni.no/">www.med.uni.no/</a>
Karolinska Institutet IMPI	<a href="http://www.ki.se/impi">www.ki.se/impi</a>
Max-Planck-Institut für Immunbiologie	<a href="http://www.immunbio.mpg.de">www.immunbio.mpg.de</a>
Max-Planck-Institut für Infektionsbiologie	<a href="http://www.mpiib.berlin.mpg.de">www.mpiib.berlin.mpg.de</a>
MRC National Institute for Medical Research	<a href="http://www.nimr.mrc.ac.uk">www.nimr.mrc.ac.uk</a>
MRC Cellular Immunology Unit	<a href="http://www.molbio.ox.ac.uk">www.molbio.ox.ac.uk</a>
Pasteur Institute	<a href="http://www.pasteur.fr">www.pasteur.fr</a>
Swiss Cancer Research Institute	<a href="http://www.isrec.unil.ch">www.isrec.unil.ch</a>
South African National Bioinformatics Institute	<a href="http://www.sanbi.ac.za">www.sanbi.ac.za</a>
National Center for Biotechnology Information (NCBI)	<a href="http://www.ncbi.nlm.nih.gov">www.ncbi.nlm.nih.gov</a>
National Institute of Allergy and Infectious Diseases (NIAID)	<a href="http://www.niaid.nih.gov">www.niaid.nih.gov</a>
Research Collaboratory for Structural Bioinformatics (RCSB)	<a href="http://www.rcsb.org">www.rcsb.org</a>

Table 1. Contd.

Society	Website
Association of Medical Laboratory Immunologists	<a href="http://www.amli.org/">http://www.amli.org/</a>
Australasian Society for Immunology	<a href="http://www.wehi.edu.au/collegiate/ASI/">http://www.wehi.edu.au/collegiate/ASI/</a>
Clinical Immunology Society (CIS)	<a href="http://www.clinimmsoc.org/">http://www.clinimmsoc.org/</a>
Interasma	<a href="http://www.asmanet.com/">http://www.asmanet.com/</a>
International Association of Allergy and Clinical Immunology (IAACI)	<a href="http://www.iaaci.org/">http://www.iaaci.org/</a>
International Cytokine Society	<a href="http://bioinformatics.weizmann.ac.il/cytokine/">http://bioinformatics.weizmann.ac.il/cytokine/</a>
International Society for Analytical Cytology (Flow Cytometry)	<a href="http://www.isac-net.org/">http://www.isac-net.org/</a>
International Society for Developmental and Comparative Immunology (ISDCI)	<a href="http://www.isdci.org/">http://www.isdci.org/</a>
International Society of Exercise and Immunology (ISEI)	<a href="http://www.isei.de/">http://www.isei.de/</a>
International Union of Immunological Societies (IUIS)	<a href="http://www.qimr.edu.au/iuis/">http://www.qimr.edu.au/iuis/</a>
Federation of Clinical Immunology Societies (FOCIS)	<a href="http://www.focisnet.org/">http://www.focisnet.org/</a>
Primary Immunodeficiency Association	<a href="http://www.pia.org.uk/">http://www.pia.org.uk/</a>
Psychoneuroimmunology Research Society (PNIRS)	<a href="http://www.pnirs.org/">http://www.pnirs.org/</a>
Society of Mucosal Immunology	<a href="http://www.socmucimm.org/">http://www.socmucimm.org/</a>
World Allergy Organisation	<a href="http://www.worldallergy.org/">http://www.worldallergy.org/</a>
European Academy of Allergology and Clinical Immunology (EAACI)	<a href="http://www.eaaci.org/">http://www.eaaci.org/</a>
European Association of Rheumatology	<a href="http://www.eular.org/">http://www.eular.org/</a>
European Federation of Immunological Societies (EFIS)	<a href="http://www.efis.org/">http://www.efis.org/</a>
European Macrophage and Dendritic Cell Society (EMDS)	<a href="http://www.macrophae.de/">http://www.macrophae.de/</a>
American Academy of Allergy, Asthma and Immunology (AAAAI)	<a href="http://www.aaaai.org/">http://www.aaaai.org/</a>
American Association of Immunologists (AAI)	<a href="http://www.aai.org/">http://www.aai.org/</a>
American Society for Histocompatibility and Immunogenetics (ASHI)	<a href="http://www.ashi-hla.org/">http://www.ashi-hla.org/</a>
British Society for Allergy and Clinical Immunology	<a href="http://www.soton.ac.uk/~bsaci/">http://www.soton.ac.uk/~bsaci/</a>
British Society for Histocompatibility and Immunogenetics (ASHI)	<a href="http://www.umds.ac.uk/elsewhere/tissue">http://www.umds.ac.uk/elsewhere/tissue</a>
British Society for Immunology	<a href="http://immunology.org/">http://immunology.org/</a>
Canadian Society of Allergy and Clinical Immunology	<a href="http://csaci.medical.org/">http://csaci.medical.org/</a>
French Society of Immunology	<a href="http://www.inserm.fr/sfi">http://www.inserm.fr/sfi</a>
German Society for Immunology	<a href="http://www.immunologie.de/">http://www.immunologie.de/</a>
Norwegian Society for Immunology	<a href="http://nsi.mint.no/index.html">http://nsi.mint.no/index.html</a>
Russian Society for Immunology (RSI)	<a href="http://www.rji.ru/">http://www.rji.ru/</a>

**CDMARKERS** (<http://www.ncbi.nlm.nih.gov/PROW>)

Cluster of differentiation (CD) antigen guides are authoritative, short, structured reviews on molecules which have an official "CD" designation (more than 200 guides are available). The sequences of CD antigen are available on Swissprot database. CD antigen database is also available on [www.agibiotech.org](http://www.agibiotech.org).

**CELL LINES DATABASE** (<http://www.biotech.ist.unige.it/interlab/cldb.html>)

This database is a product of the American Type Culture Collection. It contains catalogs of recombinant materials (Clones, Hosts, Libraries, IMAGE, vectors, etc), catalogs of all other collections (Bacteriology, Cell culture, Fungi, Virology, etc.), Hybridoma data bank/human tumor cell lines database. Cell line data base, the first database set up within the Interlab Project, contains detailed information on 4.850 human and animal cell lines that are

available in many Italian laboratories and in some of the most important European cell banks and cell culture collections.

**ANTIBODY** (<http://www.bioinf.org.uk/abs/>)**RESOURCE**

This website is an extensive collection of annotated links to sources of information around the web (and a few off) about antibodies. This page attempts to summarize useful information on antibody structure and sequence. It provides a query interface to the Kabat antibody sequence data, general information on antibodies and crystal structures and links to other antibody-related information.

**APOPTOSIS** (<http://www.apopnet.com>)

This is a multifunctional website created by ApopNet to

**Table 2.** Important databases and websites.

Database	Website	Function
Bodymap	<a href="http://www.bodymap.ims.u-okyo.ac.jp">www.bodymap.ims.u-okyo.ac.jp</a>	Human mouse gene expression data
Gene expression database	<a href="http://www.informatics.jax.org">www.informatics.jax.org</a>	Mouse gene expression and genomics
Interferon Stimulated gene database	<a href="http://www.lerner.ccf.org/labs">www.lerner.ccf.org/labs</a>	Gene induced by treatment with interferon
Kidney development database	<a href="http://www.golgi.ana.ed.ac.uk">www.golgi.ana.ed.ac.uk</a>	Kidney development and gene expression
Mouse atlas and gene expression database	<a href="http://www.genex.hgu.mrc.ac.uk">www.genex.hgu.mrc.ac.uk</a>	Specially mapped gene expression data
Allgenes	<a href="http://www.allgene.org">www.allgene.org</a>	Human and mouse gene index integrating gene transcript and protein annotation
EID	<a href="http://www.mcb.harvard.edu/gilbert">www.mcb.harvard.edu/gilbert</a>	Protein coding , intron containing genes
Gene resources locator	<a href="http://www.grl.gi.k.u.tokyo.ac.jp">www.grl.gi.k.u.tokyo.ac.jp</a>	Alignment of ESTs with finished human sequence
GDB	<a href="http://www.gdb.org">www.gdb.org</a>	Human genes and genomic maps
Geneatlas	<a href="http://www.citi2.fr/geneatlas">www.citi2.fr/geneatlas</a>	Human gene , markers, and phenotype
ArkDB	<a href="http://www.thearkdb.org">www.thearkdb.org</a>	Genome database for farm and other animals
Full Malaria	<a href="http://www.ims.u-tokeyo.ac.jp">www.ims.u-tokeyo.ac.jp</a>	Full length cDNA library from erythrocytic stage plasmodium falciparum

foster international scientific communication. The primary purpose of this site is to provide a cohesive collection of information regarding apoptosis research.

#### **CELL ADHESION** (<http://www.cell-adhesion.net/>)

This site is dedicated to fostering communication between researchers in the field of cell adhesion. Few services are provided to encourage communication and make it easier for cell adhesion labs to share ideas, collaborate, and keep in contact.

#### **IMMUNOLOGY LINK** (<http://www.immunologylink.com>)

This searchable site contains a great number of electronic addresses of Immunological Associations, on-line Journals, literature searches, KO/Transgenic mice, biotechnology jobs, CDantigens, scientists, products, Grad-programs, fellowship/grants, and databases.

#### **HUMAN IMMUNODEFICIENCY VIRUS (HIV) DATABASE** (<http://hiv-eb.lanl.gov>)

The HIV molecular immunology database contains an annotated, searchable collection of HIV-1 cyto-toxic helper T-cell epitopes and antibody binding sites. These data are also available in the form of a printed HIV molecular immunology compendium which is updated yearly and provided free of charge to scientific researchers.

#### **FLOW CYTOMETRY** (<http://flowcyt.cyto.purdue.edu/flowcyt/software.htm>)

Catalog of free flow cytometry software strives to be comprehensive to include all free flow cytometry software available worldwide.

#### **MACROPHAGES** (<http://dunn1.path.ox.ac.uk/~cholt/>)

This is the laboratory home page of Siamon Gordon,

at the Sir William Dunn School of Pathology in Oxford. This site contains information about mononuclear and phagocytic cells, their biology and role in human diseases.

#### **MOLECULAR IMMUNOLOGY** (<http://www.mi.interhealth.info>)

This site was created by Mr. Daniele Focosi. This is an educational resource introducing general concepts and principles of molecular immunology. The site focuses on the information needs of biologists and physicians.

#### **BIOMEDNET** (<http://www.bmn.com>)

This is a full text library of biological and medical publications/evaluated MedLine with full text links and expert annotations/HMS beagle-online magazine of science news and features/BioMedLink-database of the best web resources/job exchanges, with hundreds of job listings from around the world, etc.

**INSTITUTE FOR SCIENTIFIC INFORMATION**  
(<http://www.isinet.com>)

Institute for Scientific Information (ISI) is the publisher of current contents, the science citation index, impact factor and other databases of scholarly research information in the sciences, social sciences, and arts and humanities.

**IMMUNOGENETICS** (<http://imgt.cines.fr>)

This is a site of molecular structure of immunoglobulins, T-cell receptors and major histocompatibility complex molecules of all species.

**KABAT DATABASE OF SEQUENCES OF PROTEINS OF IMMUNOLOGICAL INTEREST**

The database is compiled by Elvin A. Kabat (1914 to 2000) and maintained by George Johnson and Tai Te Wu. This site contains searching and analysis tools (Seqhntii, variability, align-A-sequence, Subgrouping, find your family); Database archive and other resources. URL: <http://immuno.bme.nwu.edu>.

**PROTEIN SEQUENCES AND STRUCTURES**  
(<http://www.rcsb.org/pdb/links.html>)

This protein data bank website includes addresses for Expsy, Network protein sequence analysis, Blast, Blocks, Pfam, Prosite and other protein and gen databases.

**VACCINES** (<http://vaccines.com>)

This is a catalog of world vaccine sites by category: for adults, aids, parents, practitioners, researchers, etc., as well as a list of relative associations/centers/journals/organizations.

**VIRUSES** (ICTVdB;  
<http://life.anu.edu.au/viruses/welcome.html>)

ICTVdB provides access to the International Committee on Taxonomy of Viruses (ICTV), the index virum, a catalogue of all ICTV approved virus names, the universal virus database containing the descriptions of viruses and to a picture gallery of viruses. All databases have links to other prominent websites available around the world which are devoted to information about viruses, along with short and clear descriptions of each of them.

**ALLERGY** (<http://allergyweb.com>)

This searchable site contains information about allergies

for patients, physicians, health plan purchasers and the news media (URL: <http://allergy.mcg.edu>). This site has information for patients on common allergies and asthma.

**ANTIBODY RESOURCE**  
(<http://www.antibodyresource.com>)

This website is an extensive collection of annotated links to sources of information around the web (and a few off) about antibodies.

**CYTOKINES** (<http://www.uni-jena.de/~iuj/start.html>)

This is a trial to collect data on cytokines carried out by the Institute of Clinical Immunology, FSU Jena, Germany. The site contains a plethora of information about cytokines and their receptors.

**IMMUNO DEFICIENCY RESOURCE (IDR)**  
(<http://bioinf.uta.fi/idr/>)

IDR is a web accessible compendium of information on the immunodeficiencies. This resource includes tools for clinical, biochemical, genetic, structural and computational analyses as well as links to related information maintained by others.

**IMMUNOHISTOCHEMISTRY**  
(<http://immuno.hypermart.net>)

This is a comprehensive list of immunohistochemistry resources on the internet. This page contains information about institutional and personal sites, bibliography/references, immunohistochemistry laboratories and vendors/suppliers.

**INTEGRINS**  
(<http://www.geocities.com/CapeCanaveral/9629>)

This promises to collate all relevant information on the integrins and gives an already useful table of the integrin subunits and subunit combinations.

**ONLINE PROTOCOLS** (<http://www.protocol-online.net/immuno/index.htm>)

This directory of online protocol provides researchers with comprehensive collection of links to cell and molecular biology, immunology protocols, methods and tips. All the protocols listed here are linked directly to the end pages. Most of the links point to web pages hosted

by research laboratories worldwide, some to commercial sites that host very useful and general technical information.

## Conclusion

Information pools on the internet have been instrumental in transformation of working mode of research community to search and exchange information among themselves and with business clients or end users. It is encouraging to note that internet is becoming increasingly popular amongst the molecular biologist, immunologist and bioinformatics studies. Journals are now published online. Scientific article in these web journals go through the same process of review as their traditional print counterpart. This paper presents an overview of sourcing information on the web, and gets the quality information about immunology.

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