



PubMed Central, an XML-based Archive of Life Sciences Journal Articles

(at the US National Library of Medicine)

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What is PubMed Central?

- <http://ncbi.nlm.nih.gov/pmc/>
- Digital archive of life sciences journals
 - includes health policy, bioinformatics and other fields
- Participation is voluntary and limited to journals
- Journals deposit an authoritative electronic copy that must meet PMC data quality standards
- Deposits are permanent
- Copyright retained by publisher or author





Access to PMC Content

- Free access to full-text articles and supporting data
- Not necessarily “Open Access”
- Journal may delay free access to its content
 - research articles are generally free in a year or less
- Full-text searching in PMC
- Citations for all articles included in PubMed
- Fully integrated with other Entrez databases – sequence data, taxonomy, books, etc.





Some Stats

Over 2.2 million articles from over 2000 journals.

10-15,000 new records added each month

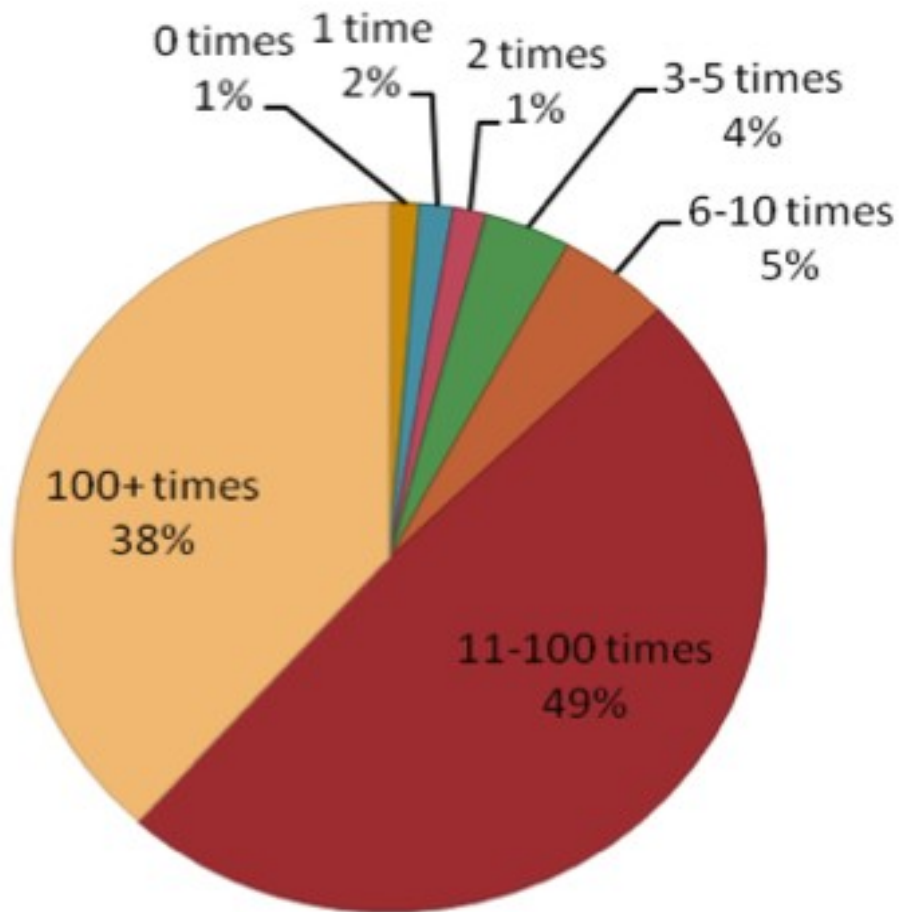
On average, over 1 million articles are retrieved by ~400,000 unique users each workday.





Usage of Articles

Article Request Frequency - Full Text Page





PMC's Archiving Philosophy

At PMC, we strive to represent the article's content or meaning rather than representing a given instance of an article (that is, the print version, an HTML version on the publisher's site, or the submitted SGML/XML).





PMC's Archiving Philosophy

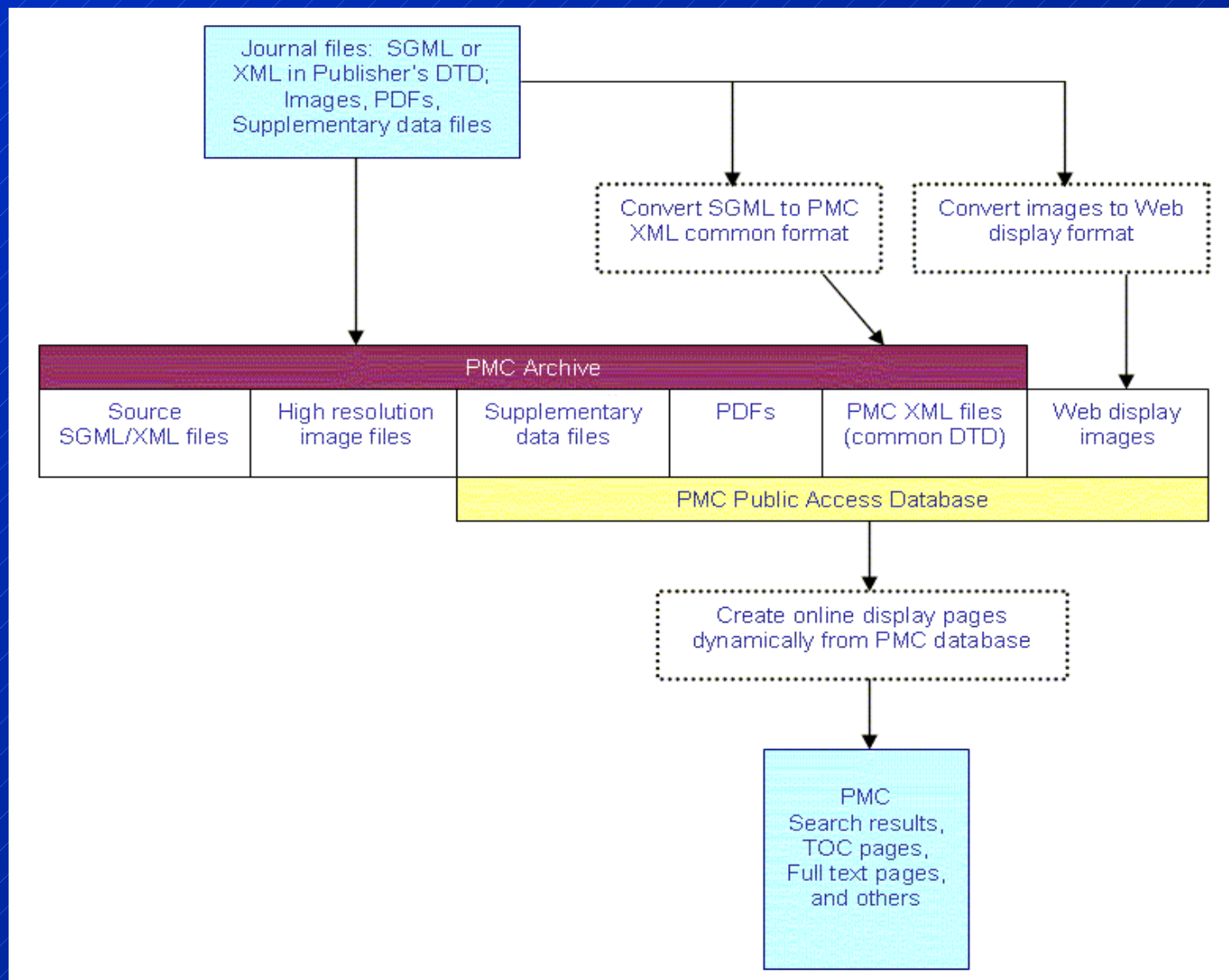
So, we:

- concentrate on representing the content of the article and not the formatting or layout.
- may use a PDF or HTML version for QA, but the QA staff understands that we don't have to have something on our page just because it was in the print version or on the publisher's website.
- may “throw away” some things in the source XML that are not needed in our model (eg, punctuation between keywords)



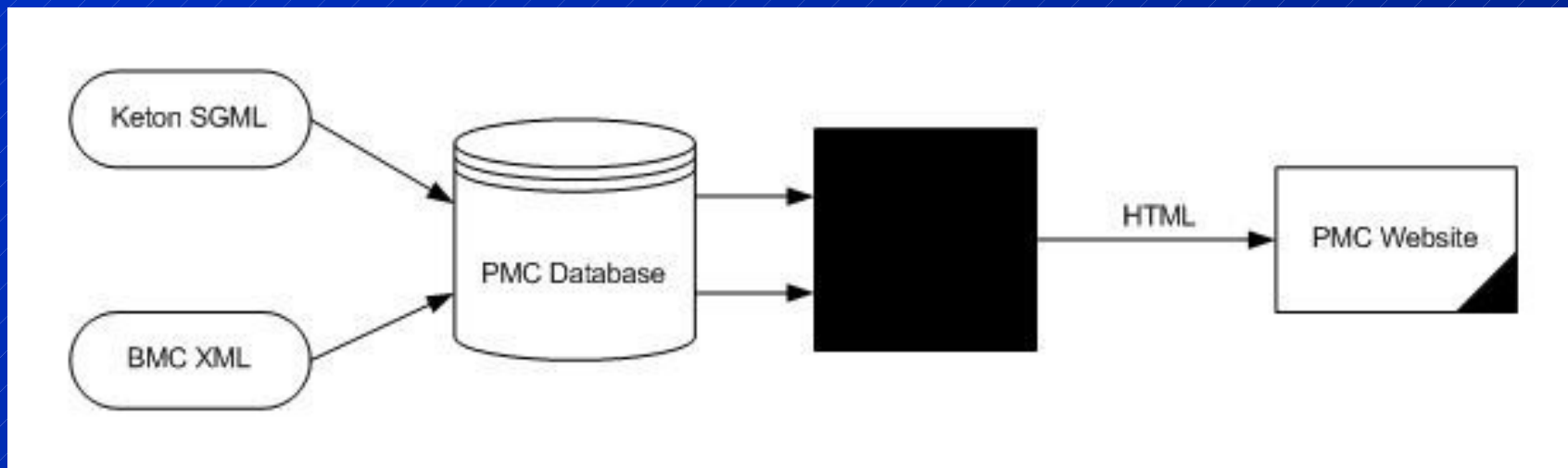


Standard PMC Workflow





Early PMC

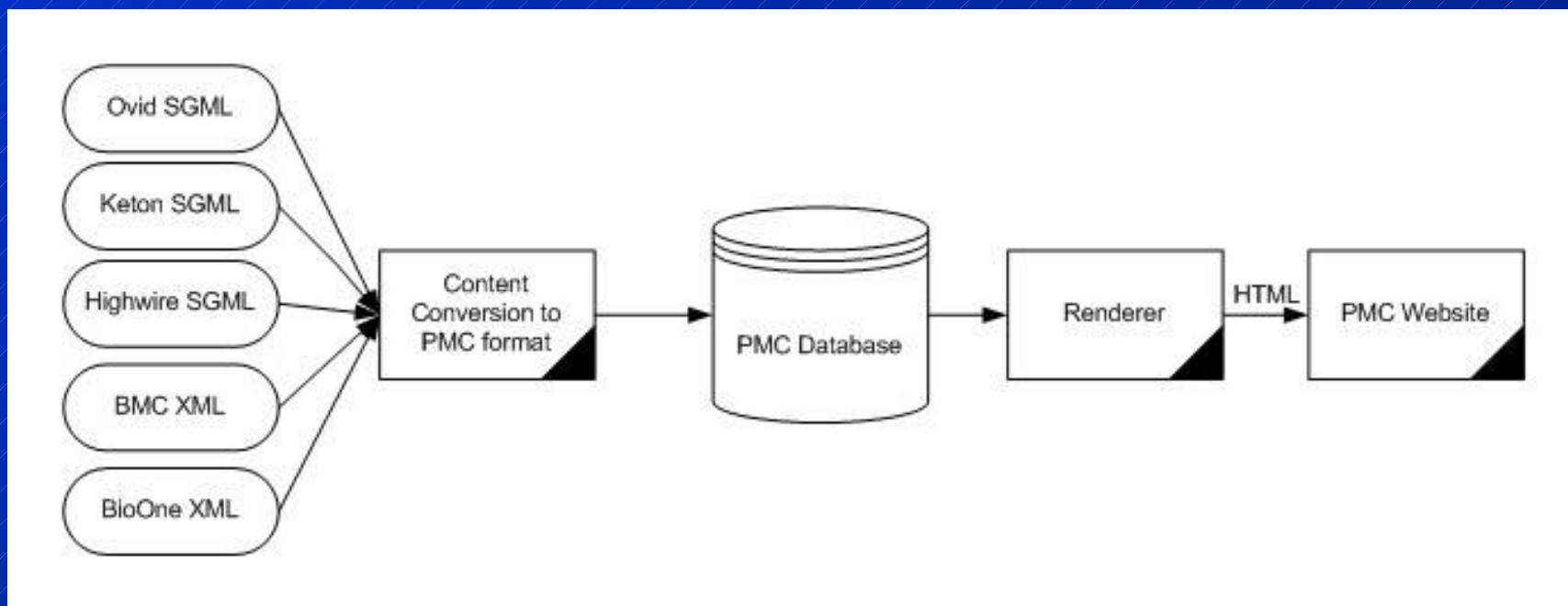


Supplied content was stored in our database in its native form and then converted to HTML when an article was requested.





Modern PMC



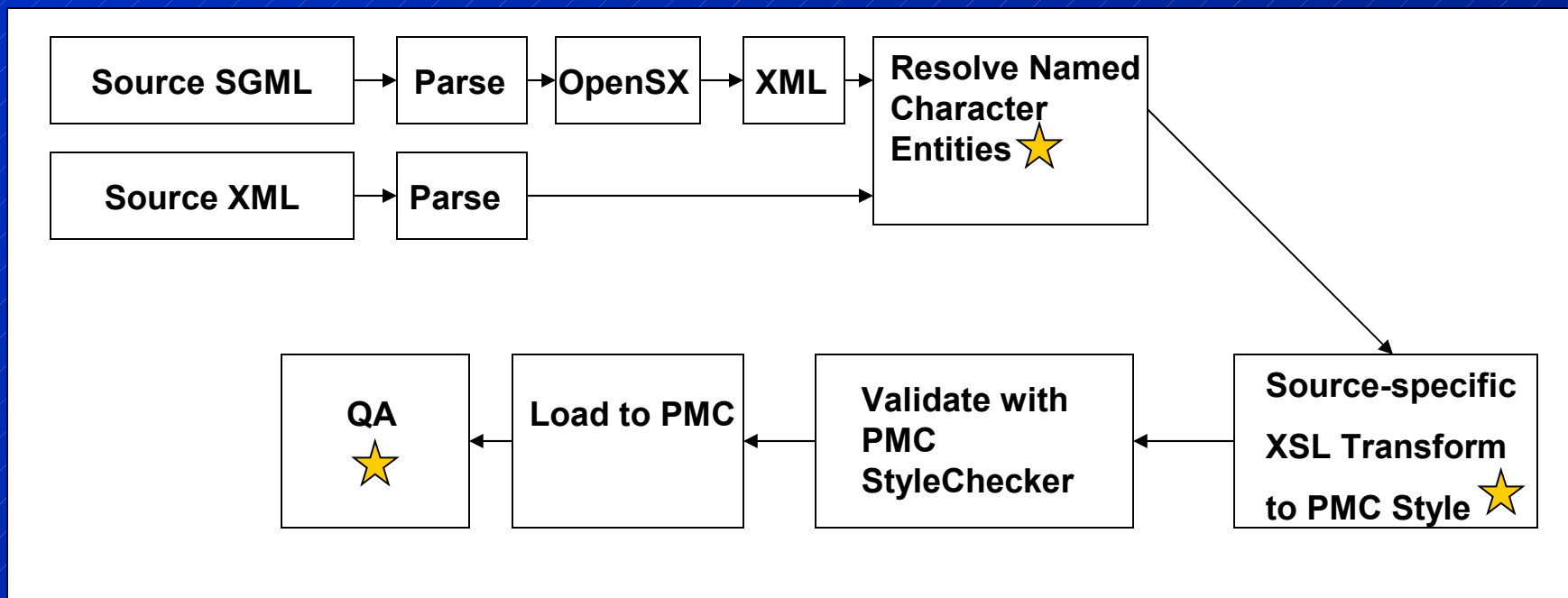
Content is converted to NLM XML* on ingest and then stored and rendered from the one format.

* Currently content is converted to the Journal Archiving and Interchange model, version 3.0





Text Processing



- ★ These steps can take a lot of time and cause you to reject or send content back for rework





PMC's XML Philosophy

For PMC to be successful, we need to load high-quality, valid, accurate, and consistent XML into the database.





To support our dual mission of Access to and Archiving of STM Journal Article Materials, we need to:

1. Have some control over what comes in.
2. Avoid constant churning of the data. Data migrations are an important part of the Archiving mission, but they take a lot of resources to do right.
3. Make it as easy as possible for submitters to make high quality XML that meets our needs.
4. Normalize all content on the way into PMC.





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PMC Eval Process

Before being accepted into PMC, journals must pass two tests:

1. Content Evaluation:

- The content must be deemed to be “in scope”

2. Data Evaluation:

- The publisher must demonstrate that it “can routinely supply files of sufficient quality to generate complete and accurate articles online without the need for human action to correct errors or omissions in the data.”





Data Evaluation

For the evaluation, a journal supplies a sample set of articles (at least 50). These articles are put through a series of automated (to check structure) and human (to check article accuracy) checks to ensure that the XML is valid and that it accurately represents the article content.

We've created a set of "Minimum Data Requirements" that must be met before the evaluation proceeds to the more human-intensive content accuracy checking





Minimum Data Requirements

Each sample package must be complete: all required data files (XML/SGML, PDF if available, image files, supplementary data files) for every article in the package must be present and named correctly.

All XML files must conform to an **acceptable** journal article DTD.

All XML/SGML files must parse according to their DTD.





Required Elements

Regardless of the XML/SGML DTD used, the following metadata information must be present and tagged with correct values in every sample file:

- Journal ISSN or other unique Journal ID
- Journal Publisher
- Copyright statement (if applicable)
- License statement (if applicable)
- Volume number
- Issue number (if applicable)
- Pagination/article sequence number
- Issue-based or Article-based publication dates. Articles submitted to PMC must contain publication dates that accurately reflect the journal's publication model.
- All image files for figures must be legible, and submitted in high-resolution TIFF or EPS format, according to the PMC Image File Requirements.





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Migration

Migration is expensive and time consuming.

To avoid unnecessary migration, the PMC database, indexing, and rendering software supports content from version 1.0 of the DTD through version 3.0.





DTDs and DTDs

This gives us eight versions of the NLM article model to work with (number 8 is NISO JATS 0.4).

Additionally, we maintain copies of almost 40 DTDs that we receive content in. Many of these have multiple versions.

We have copies of the DTDs in our local system for ease of use and copies available through http so that they can be used by others using our software (UK PMC, PMC Canada).





Catalog File(s)

We maintain the mappings of all of the DTDs, DTD files and PUBLIC and SYSTEM IDs in an XML Catalog file.





Ta - Da!

```
<?xml version="1.0" encoding="utf-8"?>
<!DOCTYPE catalog PUBLIC "-//OASIS/DTD Entity Resolution XML Catalog V1.0//EN" "oasiscatalog.dtd">
<catalog xmlns="urn:oasis:names:tc:entity:xmlns:xml:catalog">

<!-- ===== -->
<!-- JOURNAL PUBLISHING DTD (BLUE) 3.1 -->
<!-- ===== -->

<group xml:base="/pmc/load/converter3/dtd/nlm/" prefer="public">
  <public publicId="-/NLM/DTD Journal Publishing DTD v3.1 20100601//EN" uri="3.1/journalpublishing3.dtd"/>
  <public publicId="-/NLM/DTD Journal Publishing DTD-Specific Modules v3.1 20100601//EN" uri="3.1/journalpubcustom-modules3.ent"/>
  <public publicId="-/NLM/DTD Journal Publishing DTD Customize Classes Module v3.1 20100601//EN" uri="3.1/journalpubcustom-classes3.ent"/>

  <public publicId="-/NLM/DTD Journal Publishing DTD Customize Mixes Module v3.1 20100601//EN" uri="3.1/journalpubcustom-mixes3.ent"/>
  <public publicId="-/NLM/DTD Journal Publishing DTD Customize Content and Attributes Module v3.1 20100601//EN" uri="3.1/journalpubcustom-
models3.ent"/>

  <public publicId="-/NLM/DTD NLM Citation v3.1 20100601//EN" uri="3.1/nlmcitation.ent3"/>
</group>

<!-- ===== -->
<!-- JOURNAL ARTICLE AUTHORIZING DTD (PUMPKIN) 3.1 -->
<!-- ===== -->

<group xml:base="/pmc/load/converter3/dtd/nlm/" prefer="public">
  <public publicId="-/NLM/DTD Article Authoring DTD v3.1 20100601//EN" uri="3.1/articleauthoring3.dtd"/>
  <public publicId="-/NLM/DTD Article Authoring DTD-Specific Modules v3.1 20100601//EN" uri="3.1/articleauthcustom-modules3.ent"/>
  <public publicId="-/NLM/DTD Article Authoring DTD Over-ride Classes Module v3.1 20100601//EN" uri="3.1/articleauthcustom-classes3.ent"/>
  <public publicId="-/NLM/DTD Article Authoring DTD Over-ride Mixes Module v3.1 20100601//EN" uri="3.1/articleauthcustom-mixes3.ent"/>
  <public publicId="-/NLM/DTD Article Authoring DTD Over-ride Content and Attribute Module v3.1 20100601//EN" uri="3.1/articleauthcustom-
models3.ent"/>
</group>

<!-- ===== -->
<!-- JOURNAL ARTICLE ARCHIVING DTD (GREEN) 3.1 -->
<!-- ===== -->

<group xml:base="/pmc/load/converter3/dtd/nlm/" prefer="public">
  <public publicId="-/NLM/DTD Journal Archiving and Interchange DTD v3.1 20100601//EN" uri="3.1/archivearticle3.dtd"/>
  <public publicId="-/NLM/DTD Journal Archiving DTD-Specific Modules v3.1 20100601//EN" uri="3.1/archivecustom-modules3.ent"/>
  <public publicId="-/NLM/DTD Journal Archiving DTD Customize Classes Module v3.1 20100601//EN" uri="3.1/archivecustom-classes3.ent"/>
  <public publicId="-/NLM/DTD Journal Archiving DTD Customize Mixes Module v3.1 20100601//EN" uri="3.1/archivecustom-mixes3.ent"/>
  <public publicId="-/NLM/DTD Journal Archiving DTD Customize Content and Attributes Module v3.1 20100601//EN" uri="3.1/archivecustom-
```





```
<!-- ===== -->
<!--      JOURNAL ARTICLE ARCHIVING OASIS DTD      -->
<!-- ===== -->

<group xml:base="/pmc/load/converter3/dtd/nlm/" prefer="public">
  <public publicId="-/NLM//DTD Journal Archiving and Interchange DTD v3.1 20100601//EN" uri="3.1/archive-oasis-article3.dtd"/>
  <public publicId="-/NLM//DTD Journal Archiving DTD-Specific Modules v3.1 20100601//EN" uri="3.1/archive-oasis-custom-
modules3.ent"/>
  <public publicId="-/NLM//DTD Journal Archiving DTD Customize Classes Module v3.1 20100601//EN" uri="3.1/archive-oasis-custom-
classes3.ent"/>
  <public publicId="-/NLM//DTD Journal Archiving DTD Customize Mixes Module v3.1 20100601//EN" uri="3.1/archive-oasis-custom-
mixes3.ent"/>
</group>

<!-- ===== -->
<!--      JOURNAL ARTICLE PUBLISHING OASIS DTD      -->
<!-- ===== -->

<group xml:base="/pmc/load/converter3/dtd/nlm/" prefer="public">
  <public publicId="-/NLM//DTD Journal Archiving and Interchange DTD v3.1 20100601//EN" uri="3.1/journalpublishing-oasis3.dtd"/>
  <public publicId="-/NLM//DTD Journal Archiving DTD-Specific Modules v3.1 20100601//EN" uri="3.1/journalpub-oasis-custom-
modules3.ent"/>
  <public publicId="-/NLM//DTD Journal Archiving DTD Customize Classes Module v3.1 20100601//EN" uri="3.1/journalpub-oasis-
custom-classes3.ent"/>
</group>

<!-- ===== -->
<!--      ARCHIVING AND INTERCHANGE DTD SUITE      -->
<!--      MODULAR LIBRARY                          -->
<!-- ===== -->

<group xml:base="/pmc/load/converter3/dtd/nlm/" prefer="public">
  <!--      MODULE OF MODULES      -->
  <public publicId="-/NLM//DTD Archiving and Interchange DTD Suite Module of Modules v3.1 20100601//EN" uri="3.1/modules3.ent"/>
  <!--      CLASSES AND MIXES      -->
  <public publicId="-/NLM//DTD Default Element Classes Module v3.1 20100601//EN" uri="3.1/default-classes3.ent"/>
  <public publicId="-/NLM//DTD Default Element Mixes Module v3.1 20100601//EN" uri="3.1/default-mixes3.ent"/>
</group>
```





```
<!-- ===== -->
<!-- ARCHIVING AND INTERCHANGE DTD SUITE -->
<!-- MODULAR LIBRARY -->
<!-- ===== -->

<group xml:base="/pmc/load/converter3/dtd/nlm/" prefer="public">
  <!-- MODULE OF MODULES -->
  <public publicId="-/NLM/DTD Archiving and Interchange DTD Suite Module of Modules v3.1 20100601//EN" uri="3.1/modules3.ent"/>
  <!-- CLASSES AND MIXES -->
  <public publicId="-/NLM/DTD Default Element Classes Module v3.1 20100601//EN" uri="3.1/default-classes3.ent"/>
  <public publicId="-/NLM/DTD Default Element Mixes Module v3.1 20100601//EN" uri="3.1/default-mixes3.ent"/>
  <!-- ELEMENT COMMON (SHARED) ELEMENTS/CHARACTERS -->
  <public publicId="-/NLM/DTD Archiving and Interchange DTD Suite Common (Shared) Elements Module v3.1 20100601//EN"
uri="3.1/common3.ent"/>

  <public publicId="-/NLM/DTD Archiving and Interchange DTD Suite Notation Declarations v3.1 20100601//EN" uri="3.1/notat3.ent"/>
  <public publicId="-/NLM/DTD Archiving and Interchange DTD Suite XML Special Characters Module v3.1 20100601//EN"
uri="3.1/xmlspecchars3.ent"/>

  <public publicId="-/NLM/DTD Archiving and Interchange DTD Suite Custom Special Characters Module v3.1 20100601//EN"
uri="3.1/chars3.ent"/>

  <!-- CLASS MODULES -->
  <public publicId="-/NLM/DTD Archiving and Interchange DTD Suite Journal Article Metadata Elements v3.1 20100601//EN"
uri="3.1/articlemeta3.ent"/>

  <public publicId="-/NLM/DTD Archiving and Interchange DTD Suite Back Matter Elements v3.1 20100601//EN" uri="3.1/backmatter3.ent"/>
  <public publicId="-/NLM/DTD Archiving and Interchange DTD Suite Display Class Elements v3.1 20100601//EN" uri="3.1/display3.ent"/>
  <public publicId="-/NLM/DTD Archiving and Interchange DTD Suite Formatting Element Classes v3.1 20100601//EN" uri="3.1/format3.ent"/>
  <public publicId="-/NLM/DTD Archiving and Interchange DTD Suite Journal Metadata Elements v3.1 20100601//EN" uri="3.1/journalmeta3.ent"/>
  <public publicId="-/NLM/DTD Archiving and Interchange DTD Suite Link Class Elements v3.1 20100601//EN" uri="3.1/link3.ent"/>
  <public publicId="-/NLM/DTD Archiving and Interchange DTD Suite List Class Elements v3.1 20100601//EN" uri="3.1/list3.ent"/>
  <public publicId="-/NLM/DTD Archiving and Interchange DTD Suite Math Class Elements v3.1 20100601//EN" uri="3.1/math3.ent"/>
  <public publicId="-/NLM/DTD Archiving and Interchange DTD Suite Paragraph-Like Elements v3.1 20100601//EN" uri="3.1/para3.ent"/>
  <public publicId="-/NLM/DTD Archiving and Interchange DTD Suite Subject Phrase Class Elements v3.1 20100601//EN" uri="3.1/phrase3.ent"/>
  <public publicId="-/NLM/DTD Archiving and Interchange DTD Suite Bibliographic Reference (Citation) Class Elements v3.1 20100601//EN"
uri="3.1/references3.ent"/>

  <public publicId="-/NLM/DTD Archiving and Interchange DTD Suite Related Object Element v3.1 20100601//EN" uri="3.1/related-object3.ent"/>
  <public publicId="-/NLM/DTD Archiving and Interchange DTD Suite Section Class Elements v3.1 20100601//EN" uri="3.1/section3.ent"/>
  <!-- SET UP TABLES -->
  <public publicId="-/NLM/DTD Archiving and Interchange DTD Suite XHTML Table Setup Module v3.1 20100601//EN"
uri="3.1/XHTML.tablesetup3.ent"/>

  <public publicId="-/NLM/DTD Archiving and Interchange DTD Suite OASIS XML Table Setup Module v1.2 20040830//EN" uri="3.1/oasis-
tablesetup3.ent"/>

  <!-- SET UP MATHML -->
  <public publicId="-/NLM/DTD Archiving and Interchange DTD Suite MathML Setup Module v3.1 20100601//EN" uri="3.1/mathmlsetup3.ent"/>
</group>
```





And convert this master catalog file to:

1. An SGML catalog for our SGML Tools.
2. An XML catalog that resolves through http (the xml:base values are changed to our DTD location available through the internet) for other users of the PMC software.
3. An XML catalog that plays well with Oxygen on the team's PCs.





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Making it “Easy”

Instructions

- **Information for Publishers** – includes content and technical requirements and a description of the Application and Evaluation processes.

<http://www.ncbi.nlm.nih.gov/pmc/about/pubinfo.html>

- **PMC Tagging Guidelines** – describe our “preferred XML tagging style for article submissions”. We do not require that content submitted to us be exactly to this style, but it really helps to have 1 (one, uno) answer when people ask how to tag something.

<http://www.ncbi.nlm.nih.gov/pmc/pmcdoc/tagging-guidelines/article/style.htm>

- **Minimum Data Requirements**

<http://www.ncbi.nlm.nih.gov/pmc/pmcdoc/mindatareq.pdf>





Tools

PMC StyleChecker - This is a tool that applies the rules defined in the Tagging Guidelines. It is an XSL transform that reviews each article and reports what it finds. This is the same transform that we have inline in our production process after validation against the DTD to confirm that the structures within the articles we are loading into the database meet our standards for tagging.

http://www.pubmedcentral.nih.gov/utis/style_checker/stylechecker.cgi





PMC Style Checker

http://www.pubmedcentral.nih.gov/utis/style_checker/sty

Style Report NIH PMC Tools Ref webservers RRN RRN Sample 1

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PMC Style Checker

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- Article Previewer
- XML Resources
- SGML Validator

PMC Style Checker

Use this tool to confirm whether an XML file conforms to PMC Style as defined in the [PMC XML Tagging Guidelines](#).

Enter the path or browse to your XML file and click "Check File". The results will be displayed momentarily.

Hit "Clear" to return to a clean form.

Please contact pubmedcentral@nih.gov if you have any problems with the tool.

Tagging Guidelines Email List

As you may be aware, both the Tagging Guidelines and Style Checker are updated periodically, in an effort to make the PMC archive more robust, improve the quality of the XML submitted, and ensure stability for future retrieval. PubMed Central announces these periodic changes through our [pmc-tagging-guidelines](#) email list. To subscribe, please visit <http://www.ncbi.nlm.nih.gov/mailman/listinfo/pmc-tagging-guidelines>.

[Write to PMC](#) [PMC Home](#) [PubMed](#) [NCBI](#) [NLM](#) [NIH](#)





PMC Style Checker

http://www.pubmedcentral.nih.gov/utis/style_checker/sty

Style Report NIH PMC Tools Ref webservers RRN RRN Sample 1

PMC Style Checker



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PMC Style Checker

Browse...

Check File

Clear

"Clear" will take you back to the instruction page.

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File: **nihms133815..xml**
DTD Validation: **OK**
PMC Style Check: **OK**

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Last updated: May 6, 2004





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File: **nihms133815..xml**
DTD Validation: **OK**
PMC Style Check: **Errors (1 error)**

[show all](#) / [hide all](#)

Go to the [first error](#)

[show](#)

```
101:          healing where the platelet-
derived growth factor guides fibroblast to the
> ^
```

```
> error: xref checking: xref (rid="R1") with
attribute ref-type="fig" does not point to a fig or fig-group
element. Referenced element is actually of type ref.
```

[show](#)



More Tools

Online SGML Validator [PMC10] - This is a tool that validates SGML against the SGML DTDs that we have in the PMC system as long as the PUBLIC or SYSTEM ID is recognized in our SGML Catalog file. That is, as long as we have set up the particular SGML DTD for ingest in our system.

<http://www.pubmedcentral.nih.gov/utills/validate/sgmlcheck.cgi>

Online XML Validator [PMC11] - This is a tool that validates any XML file whose SYSTEM ID is resolvable on the system or whose PUBLIC or SYSTEM ID is mapped in our XML Catalog file.

<http://www.pubmedcentral.nih.gov/utills/validate/xmlcheck.cgi>





The Article Previewer

PMC Article Previewer - This is a tool that runs an article through a PMC ingest workflow. First the SGML or XML is validated against the DTD per the rules given above for the SGML and XML validators. Then, if we recognize the DTD and have a conversion built for it, the article runs through the XSL transform to normalized PMC XML. This output is validated against the output DTD and is checked with the StyleChecker. If successful at all of these steps, the article is displayed on a page in PMC display format so that the publisher can preview the article. Also, he has a good idea that his article will be ingested into PMC with no problems.





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PMC Article Previewer

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PMC Article Previewer

Quick start: Select your file by clicking "Browse..." and then "Upload Article". To view the rendered article, click the "Full Text" link under the article citation.
(Note that the process takes approximately 5-10 minutes.)

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[Full Instructions](#)

[Frequently Asked Questions](#)

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These are the articles that have been loaded by jeffbeck

Pages: 1

Eukaryotic Chemotaxis

Wouter-Jan Rappel and William F. Loomis

Wiley Interdiscip Rev Syst Biol Med. 2009; 1(1): 141–149. doi: 10.1002/wsbm.28.

loaded: Jul 26 2010 8:25AM

[| Details | Full Text | Delete |](#)

World species of the genus *Platyscelio* Kieffer (Hymenoptera: Platygasteridae)

Charuwat Taekul, Norman F. Johnson, Lubomir Masner, Andrew Polaszek, and Rajmohana K.

2010 June 30; (50): 97–126. doi: 10.3897/zookeys.50.485.

loaded: Jul 12 2010 6:16PM

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Parisognoriste, a new genus of Lygistorrhinidae (Diptera: Sciaroidea) from the Oise amber with redescription of *Palaeognoriste* Meunier

Vladimir Blagoderov, Heikki Hippa, and André Nel

2010 June 30; (50): 79–90. doi: 10.3897/zookeys.50.506.





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This is not an official PubMed Central article. It is just a test of an XML file.

My Articles > Wiley Interdiscip Rev Syst Biol Med. 2009; 1(1): 141–149.

Abstract

Full Text

PubMed articles
by:

Rappel, W.

Loomis, W.

Wiley Interdiscip Rev Syst Biol Med. Author manuscript; available in PMC 2010 July 13.

PMCID: PMC84308
NIHMSID: NIHMS133815

Published in final edited form as:

Wiley Interdiscip Rev Syst Biol Med. 2009; 1(1): 141–149.

doi: [10.1002/wsbm.28](https://doi.org/10.1002/wsbm.28).

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Eukaryotic Chemotaxis

Wouter-Jan Rappel and William F. Loomis

Departments of Physics and Biology University of California, San Diego La Jolla, CA 92093

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Abstract

During eukaryotic chemotaxis, external chemical gradients guide the crawling motion of cells. This process plays an important role in a large variety of biological systems and has wide ranging medical implications. New experimental techniques including confocal microscopy and microfluidics have advanced our understanding of chemotaxis while numerical modeling efforts are beginning to offer critical insights. In this short review, we survey the current experimental status of the field by dividing chemotaxis into three distinct “modules”: directional sensing, polarity and motility. For each module, we attempt to point out potential new directions of research and discuss how modeling studies interact with experimental investigations.

Keywords: actin, cAMP, motility, pseudopod, modeling, *Dictyostelium*, neutrophils

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Abstract

Directional
sensing

Chemotaxis is defined as directed movement of cells up or down a chemical gradient. Here we focus on chemotaxis in eukaryotic cells where the gradient sensing results in directed cell motion in the





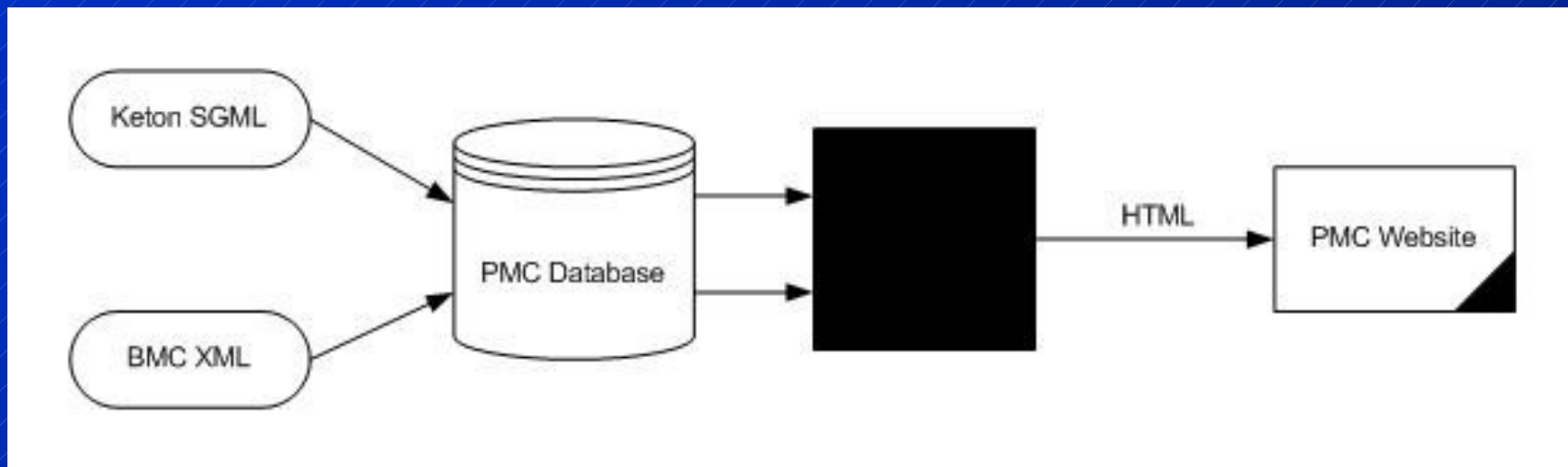
To support our dual mission of Access to and Archiving of STM Journal Article Materials, we need to:

1. Have some control over what comes in.
2. Avoid constant churning of the data. Data migrations are an important part of the Archiving mission, but they take a lot of resources to do right.
3. Make it as easy as possible for submitters to make high quality XML that meets our needs.
4. Normalize all content on the way into PMC.





Early PMC

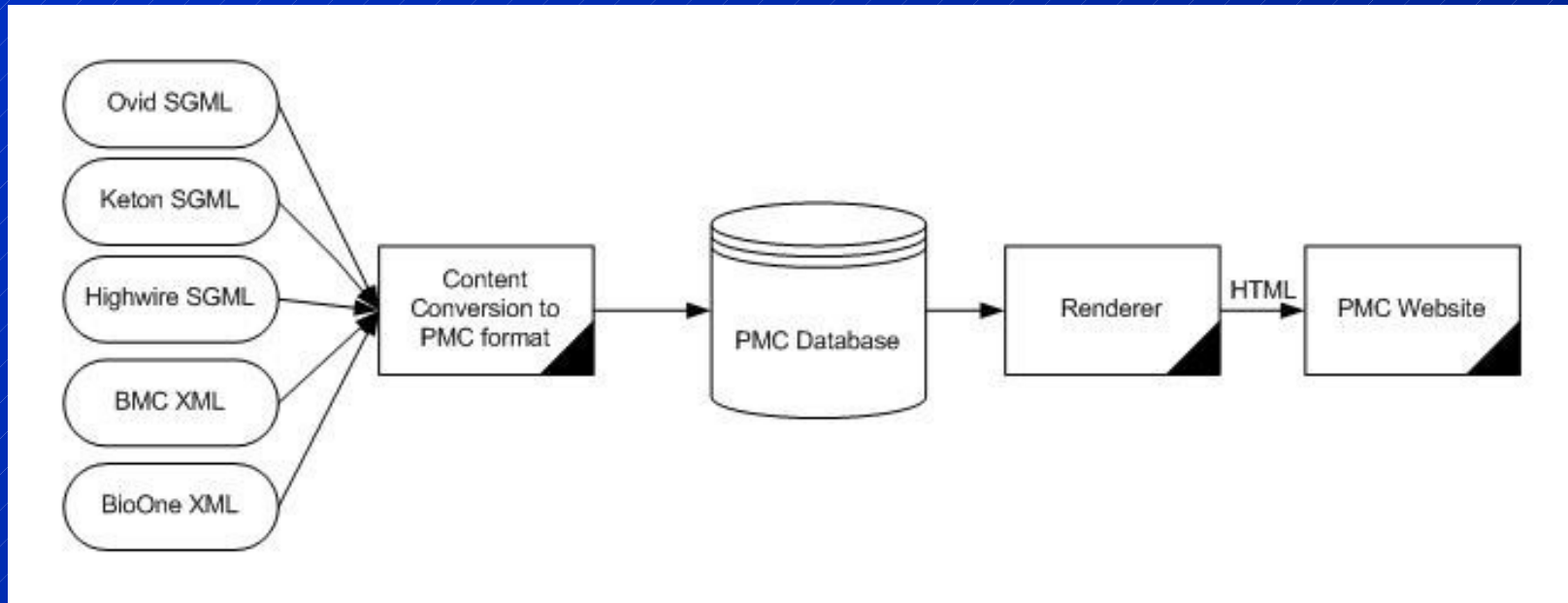


Supplied content was stored in our database in its native form and then converted to HTML when an article was requested.





The Other Black Box



Conversion of Source to normalized XML

- inconsistent use of source models
- each journal requires analysis over time
- SGML created from print files
- Content is just wrong!





(maybe a gray box)

All content runs through an ingest conversion coming into PMC.

This is both for checking and normalizing.

Because we require all content be in “PMC Style” when it goes into the database, but not when it is submitted.





Disclaimer as a Conclusion

Things have aligned to make our job easy (relatively)

1. The content is really very regular – the journal article has been around for a long time and authors and readers expect it to be structured a certain way.
2. Submitters are motivated (sometimes compelled) to provide their content.
3. Resources (not unlimited, of course, but not bad).

