The Guide to IMMUNOPHARMACOLOGY (GtoImmuPdb) is a Wellcome Trust-funded extension to the existing Guide to PHARMACOLOGY (GtoPdb). The development of GtoImmuPdb aims to provide improved data exchange between immunology and pharmacology expert communities, so to better support research and development of drugs targeted at modulating immune, inflammatory or infectious components of disease.

The underlying GtoPdb schema has been extended to incorporate new immune system specific data types (such as processes and cell types) and the GtoPdb website has been developed to surface this new data and incorporate it into the existing search and browse mechanisms. A new Guide to IMMUNOPHARMACOLOGY portal has been developed, which serves as a unique immunological access-point to the Guide to PHARMACOLOGY.

http://www.guidetoimmunopharmacology.org

The portal has its own unique branding (header bar, logo and colour scheme) to distinguish it, but retains many of the layout features from the main GtoPdb site. This consistency should help users already familiar with GtoPdb to orientate themselves with the new GtoImmuPdb.

Users can familiarise themselves with the existing GtoPdb site by reading the website tutorial:

http://www.guidetopharmacology.org/GuidetoPHARMACOLOGY_Tutorial.pdf

The guide in this document gives an overview of the GtoImmuPdb portal, and illustrates the new additions to existing pages that have been developed for GtoImmuPdb.

Information on the new data incorporated into GtoImmuPdb is described in more detail in other documentation.

http://www.guidetoimmunopharmacology.org/immuno/immunoHelpPage.jsp#aboutData
The GtoImmuPdb portal provides a unique access point to data of immunological relevance held in the database.

The main panels (highlighted by the dotted line) are fast routes into browsing the data by the main data-type categories:

- Processes
- Cell Types
- Disease
- Targets
- Ligands

These are explained in more detail later in the tutorial. Click on the category to jump to that section.

The menu bar can also be used to browse the different data types. It also provides background information under the About tab and help documentation under Resources. These also contain information about the parent GtoPdb resource.

The site search in the top right can be used to search across all data. The predictive text feature provides suggestion. View tutorial on searching GtoImmuPdb. When searching from the Guide to IMMUNOPHARMACOLOGY results will be up-weighted based on their immuno relevance (see Help on Searching GtoImmuPdb).
To view targets associated with immunological processes, select a process category from the 'Processes/pathways' panel on the GtoImmuPdb portal.

You can also select a category under the Processes menu item.

The list of targets is split by target class. The 'Jump to' links allow you to move fast to that section of the table.

The blue pull-down menu can be used to switch between different process categories.

The table lists the target name (and family) and links to its detailed target page.

Gene Ontology annotations (GO) are displayed plus general curated immunopharmacology comments related to the target.
To view targets associated with immunological cell types, select a cell type category from the 'Cell Types' panel on the GtoImmuPdb portal.

You can also select a category under the Cell Types menu item.

The list of targets is split by target class. The 'Jump to' links (1) allow you to move fast to that section of the table.

The blue pull-down menu (2) can be used to switch between different cell type categories.

The table lists the target name (3) (and family) and links to its detailed target page.

Cell Ontology annotations (4) are displayed plus general curated immunopharmacology comments (5) related to the target.

### Guide to IMMUNOPHARMACOLOGY

#### Cell Type Associations to Targets

<table>
<thead>
<tr>
<th>B-cells</th>
<th>T-cells (alpha/beta)</th>
<th>Dendritic cells</th>
<th>Other T-cells (NKT, MAIT, TRM etc.)</th>
<th>Macrophages &amp; monocytes</th>
<th>Granulocytes</th>
<th>Natural killer (NK) cells</th>
<th>Mast cells</th>
<th>Innate lymphoid cells</th>
<th>Stromal cells</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The blue pull-down menu can be used to switch between different cell type categories.

The table lists the target name (and family) and links to its detailed target page.

Cell Ontology annotations are displayed plus general curated immunopharmacology comments related to the target.

<table>
<thead>
<tr>
<th>DisPROD receptor name (family)</th>
<th>Cell Type Association Comments</th>
<th>Cell Ontology Associations</th>
<th>Immunopharmacology Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The text describes the functionalities and interactions of the targets associated with immunological cell types, including the use of the portal and menu options for viewing and navigating the data.

---

**Guide to IMMUNOPHARMACOLOGY**

*Cell Type Associations to Targets*

- **B-cells**
- **T-cells (alpha/beta)**
- **Dendritic cells**
- **Other T-cells (NKT, MAIT, TRM etc.)**
- **Macrophages & monocytes**
- **Granulocytes**
- **Natural killer (NK) cells**
- **Mast cells**
- **Innate lymphoid cells**
- **Stromal cells**

The list of targets is split by target class. The 'Jump to' links allow you to move fast to that section of the table. The blue pull-down menu can be used to switch between different cell type categories.

The table lists the target name (and family) and links to its detailed target page. Cell Ontology annotations are displayed plus general curated immunopharmacology comments related to the target.
Disease association data is organised into two sets: **target associations** and ligand associations. These are accessed by selecting the links from the Disease panel on the portal (or via the Disease menu item).

The page is organised with a tab to switch (1) between the target and ligand associations.

Each section of the table shows one disease, with external references. The number of target associations is displayed (2), and the first three targets are listed. Clicking the link shows/hides the details (2).

Target names and curator comments are shown (3), the ligand column (4) shows ligands that interact with the target, highlighting if it’s a primary target for the ligands an if it is an approved drug. Target names link to their detailed view pages.

Buttons enable the detailed views for all target-disease associations to be shown/hidden (5).
Disease association data is organised into two sets; target associations and ligand associations. These are accessed by selecting the links from the Disease panel on the portal (or via the Disease menu item).

The page is organised with a tab to switch (1) between the target and ligand associations.

Each section of the table shows one disease, with external references. The number of ligand associations is displayed (2), and the first 5 ligands are listed. Clicking the link shows/hides the details (2).

Ligand names and curator comments are shown (3), the ligand names link to the ligand summary page for that ligand.

Buttons enable the detailed views for all ligand-disease associations to be shown/hidden (4).
Users can browse for different targets by selecting one of the main target classes on the Targets panel.

This links to the target families page for that class. Clicking on a family brings up the family page.

The family page lists all targets for that family. There are links to the detailed view page for each target.

The detailed view page shows all curated information about that target. Including highlighted immunological data.
1. Target families are displayed in a hierarchical tree (as in GtoPdb)

2. The target families page contains a toggle button that can be used to switch between the GtoImmuPdb view and the normal, GtoPdb view.

3. When selected toggle on, target families that contain target flagged in the database as being of immunological relevance are highlighted in blue.

- **G protein-coupled receptors**
  - Orphan and other 7TM receptors
    - Class A Orphans
    - Class B Orphans
    - Class C Orphans
    - Taste 1 receptors
    - Taste 2 receptors
    - Other 7TM proteins
  - 5-Hydroxytryptamine receptors
  - Acetylcholine receptors (muscarinic)
  - Adenosine receptors
  - Adhesion Class GPCRs
  - Adrenoceptors
    - Angiotensin receptors
    - APelin receptor
    - Bile acid receptor
    - Bombesin receptors
    - Bradykinin receptors
    - Calcitonin receptors
    - Calcium-sensing receptor
    - Cannabinoid receptors
    - Chemerin receptor
    - Chemokine receptors
    - Cholecystokinin receptors
    - Class Frizzled GPCRs
    - Complement peptide receptors
    - Corticotropin-releasing factor receptors
    - Dopamine receptors
    - Endothelin receptors
1. The family page also has a toggle to switch between GtoImmuPdb and GtoPdb

2. When switch on, target flagged as having immunological relevance are highlighted

3. Clicking the 'More detailed page' link moves to the detailed view for that target
1. The detailed view also has a toggle, and informs the user if the displayed target has been curated in GtolImmuPdb.

2. With the GtolImmuPdb view switched on, sections of immunological relevance are highlighted within the 'Contents' section - alerting the user to them. Clicking those jumps down to those sections.

3. When selected toggle on, target families that contain target flagged in the database as being of immunological relevance
CD80 (B7-1) is expressed on dendritic cells and activated B cells and monocytes. It is required to provide a costimulatory signal necessary for T cell activation and survival. CD80 works in concert with CD86 to prime T cells. CD80 binds CD28 and CTLA-4 on T cells. It is the interaction with CTLA-4 that is targeted by the approved immunosuppressive drugs abatacept and belatacept.

The immunopharmacology comments are rich, curator comments specific to the target about its relevance to immunopharmacology. Usually these will refer to the target's involvement with different processes, cell types, and disease.

Macrophages & monocytes
macrophage (CL:0000235)
monocyte (CL:0000576)

Dendritic cells
dendritic cell (CL:0000451)

Cell type associations show one sub-section per top-level cell type category. Associations with specific Cell Ontology terms are shown along with curator comments and references.

T cell (activation)

Associated to GO processes
T cell costimulation (GO:0031206) TAS
T cell activation (GO:0042110) IC
positive regulation of T-helper 1 cell differentiation (GO:0045627) NAS
positive regulation of alpha-beta T cell proliferation (GO:0045641) IEA

Process associations show one sub-section per top-level process category. Associations with specific Gene Ontology terms (and evidence codes) are shown along with curator comments and references.

Rheumatoid arthritis

CD80 is a primary target of the ligand abatacept, which is clinically approved for the treatment of rheumatoid arthritis.

Disease Name: Rheumatoid arthritis
Disease Synonyms: no synonyms
Comment: CD80 is a primary target of the ligand abatacept, which is clinically approved for the treatment of rheumatoid arthritis.
Disease X-refs: Disease Ontology: DOID:7148
OMIM: 180300
References: 3

Each sub-section gives details of the association between the target and a disease. It lists disease synonyms and curator comments. External links to other disease resources are provided.
Users can browse for different ligands by selecting one of the ligand categories on the Ligands panel.

Ligand categories can also be selected under the Ligands menu item.

The ligand list page is organised by category – which can be selected by the tabs at the top of the page (1).

Ligands are listed alphabetically, and link to their summary pages (2). Any ligands tagged in the database as being immuno relevance display the immuno icon (3).

All immuno tagged ligands are shown under the Immuno ligands tab.

A toggle button allows switching between the GtoImmuPdb and GtoPdb views (4).
The ligands summary pages contains detailed information about the ligand. In GtoImmuPdb.

1. Tagged ligands have an Immunopharmacology tab that contains immuno relevant data.

2. The immunopharmacology comments sections contains specific curators comments about the ligands relevance to immunopharmacology.

3. The immunopharmacology disease section shows all immune-related diseases the ligand is associated with, including curator comments and external references for the disease.
Search mechanisms have been extended to incorporate all additional immunopharmacological data – this includes all process, cell type and disease terms, definitions and ontology IDs. Running searches on GtoImmuPdb will up-weight results of higher immunological relevance.

**Example search results for 'Cytokine production' shows hits against targets under the GtoImmuPdb process category 'Cytokine production & signalling'.**

**Example search results for 'Granulocytes' shows hits against targets under the GtoImmuPdb cell type category 'Granulocytes'.'