



BizInt Smart Charts

SINCE 1996

Challenges in Visualizing Pharmaceutical Business Information



April 2013

II-SDV, Nice, France

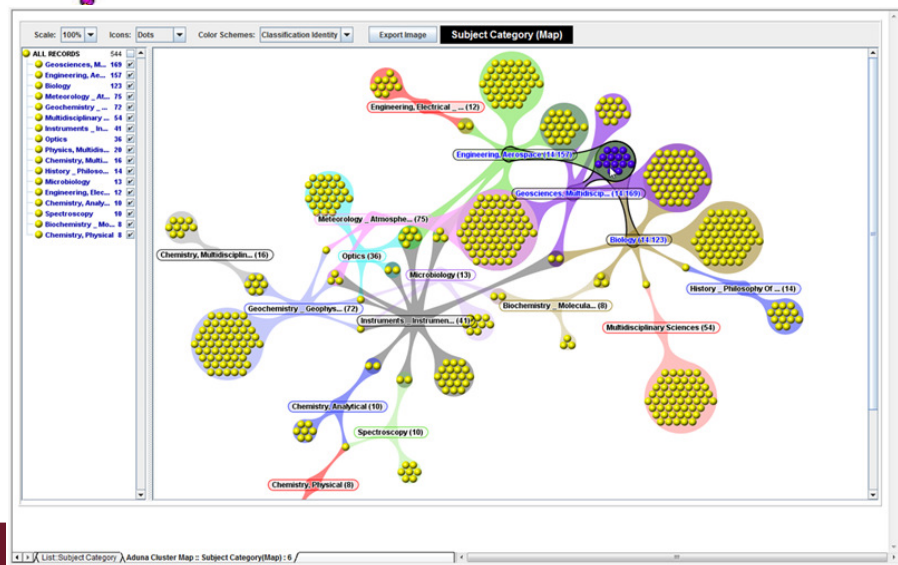
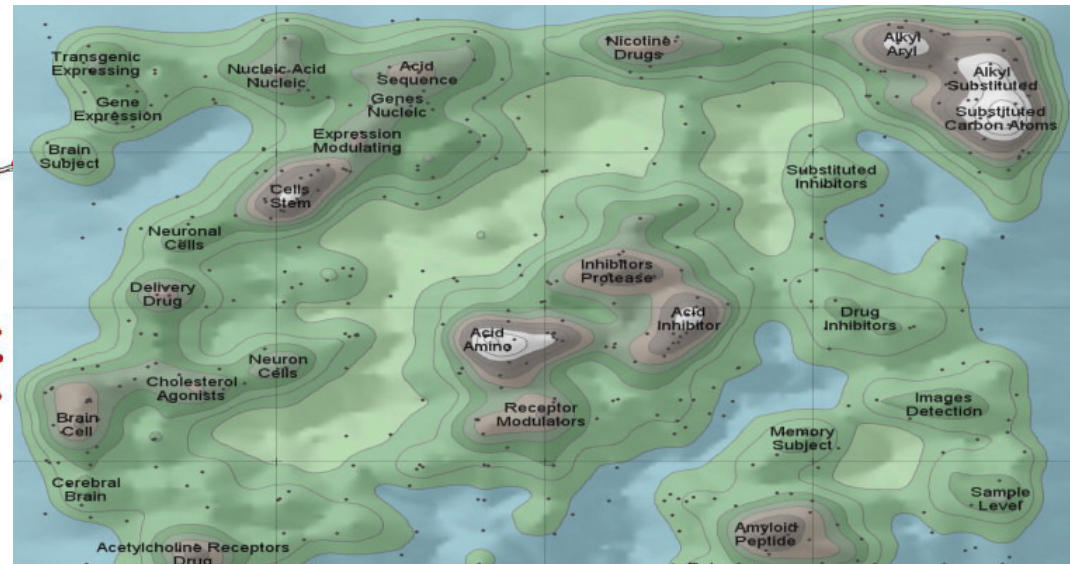
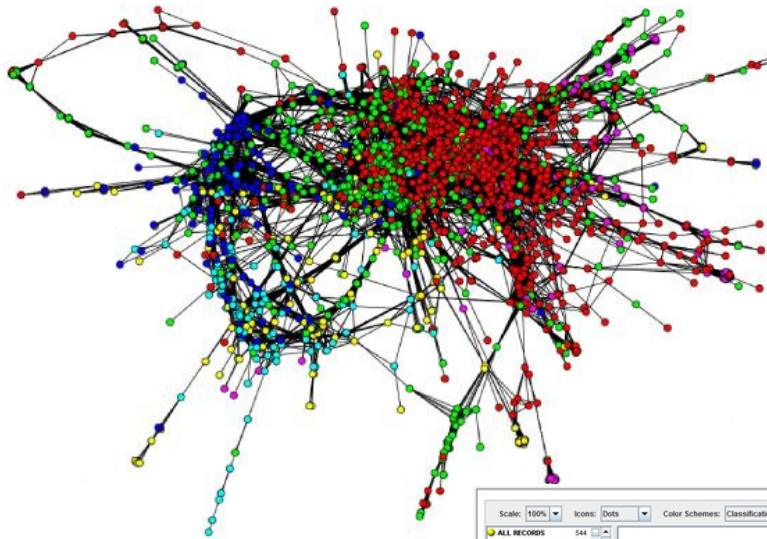
Diane Webb, President, BizInt Solutions Inc.



The Problem:

Visualizations developed for scientific and patent data do not do a good job of “telling the story” when applied to drug pipeline data and often need significant changes.

Examples of technical visualizations



Source: Erdi et al., Yang et al, Search Technology

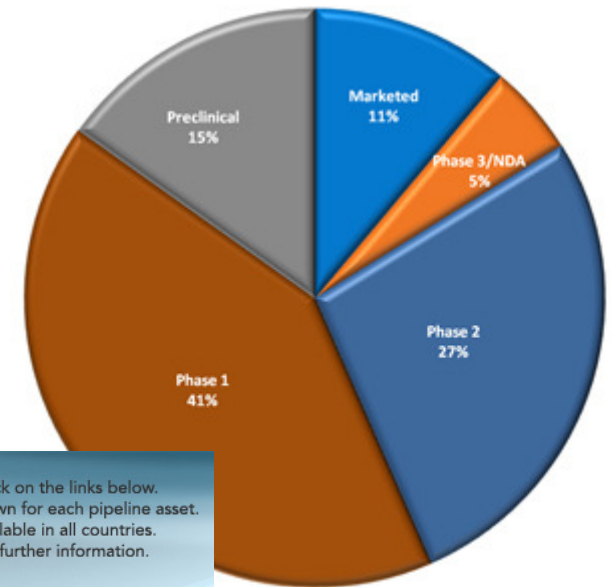
Examples of pharma pipeline visualizations



Pipeline represents progress of R&D programs as of February 28, 2013
Included are 61 NMEs, 15 additional indications, plus 2 biosimilars

Recent Approval
- Eliquis for Prevention of Stroke and Systemic Embolism in patients with Nonvalvular Atrial Fibrillation (U.S./EU)

4 projects discontinued since last update



Our Pipeline

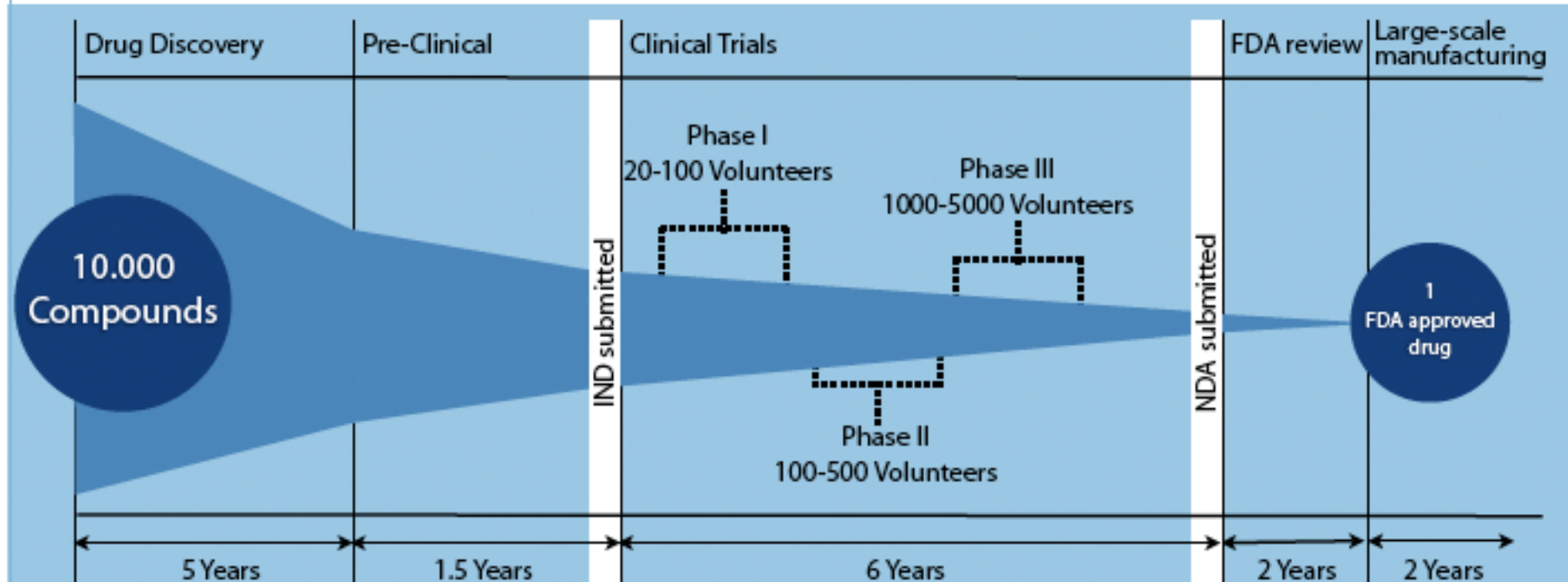
To learn more about selected products, click on the links below. Highest phase of clinical development shown for each pipeline asset. All products may not be approved and/or available in all countries. Please contact your local Amgen office for further information.



Source: Roche, Ligand, AmgenOncology websites

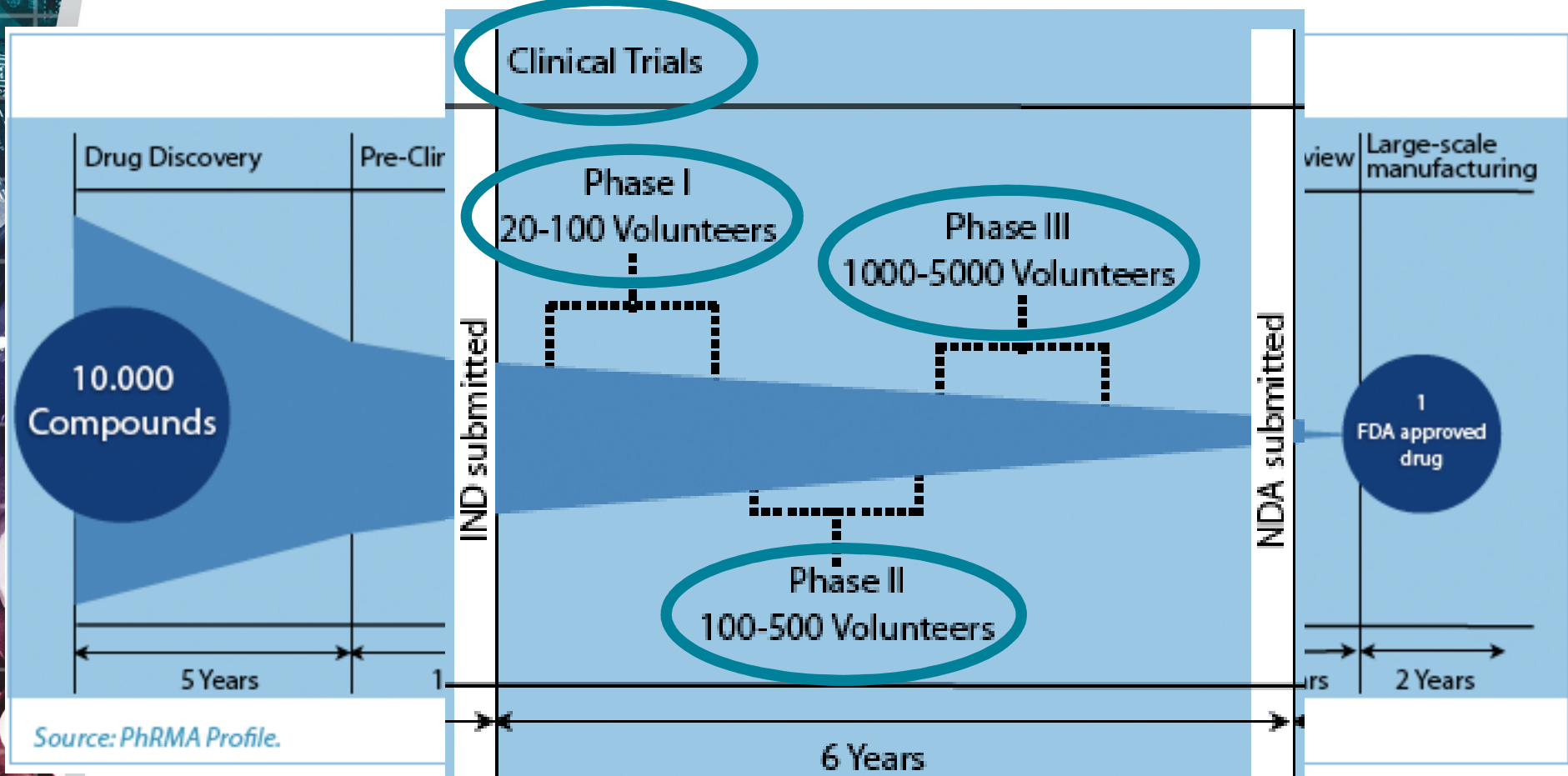
The Drug Development “Pipeline”

At each stage of the pipeline, companies need information on drugs in development to make both business and research decisions.



Source: PhRMA Profile.

Clinical Trials – Phases in the Pipeline

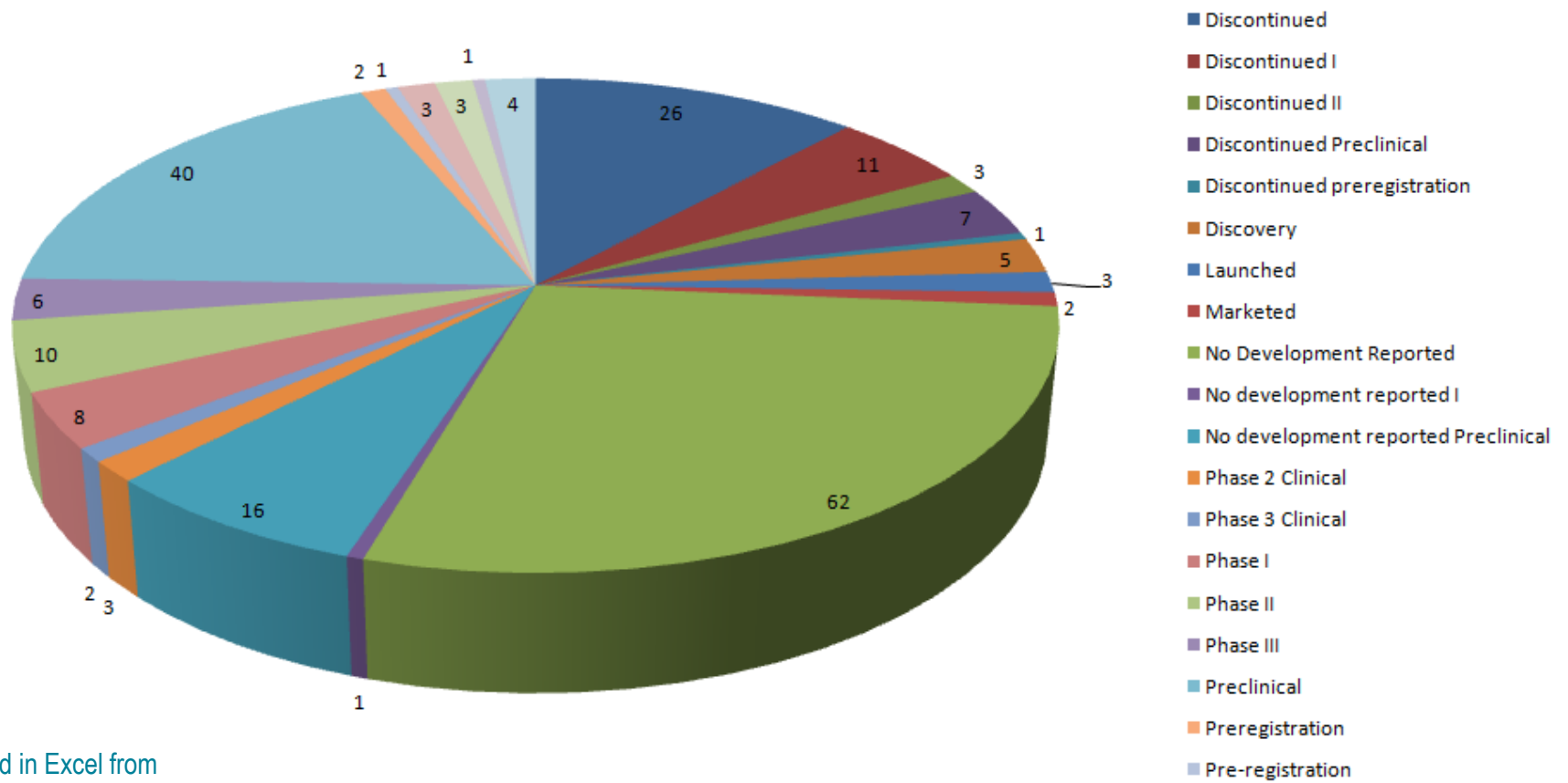


Information on drug pipelines --

- Comes from a variety of sources – company sources, published literature, conferences, industry news, etc.
- **Drug Pipelines Databases** – constructed by teams of editors at several companies, reviewing public and proprietary sources.
- Sold to the pharmaceutical industry for competitive intelligence on drug pipelines.
- Examples: Pharmaprojects, Integrity, R&D Focus

An example of a company pipeline graph

Number of Drugs in Company Pipeline by Phase - Human Genome Sciences - from 4 Databases

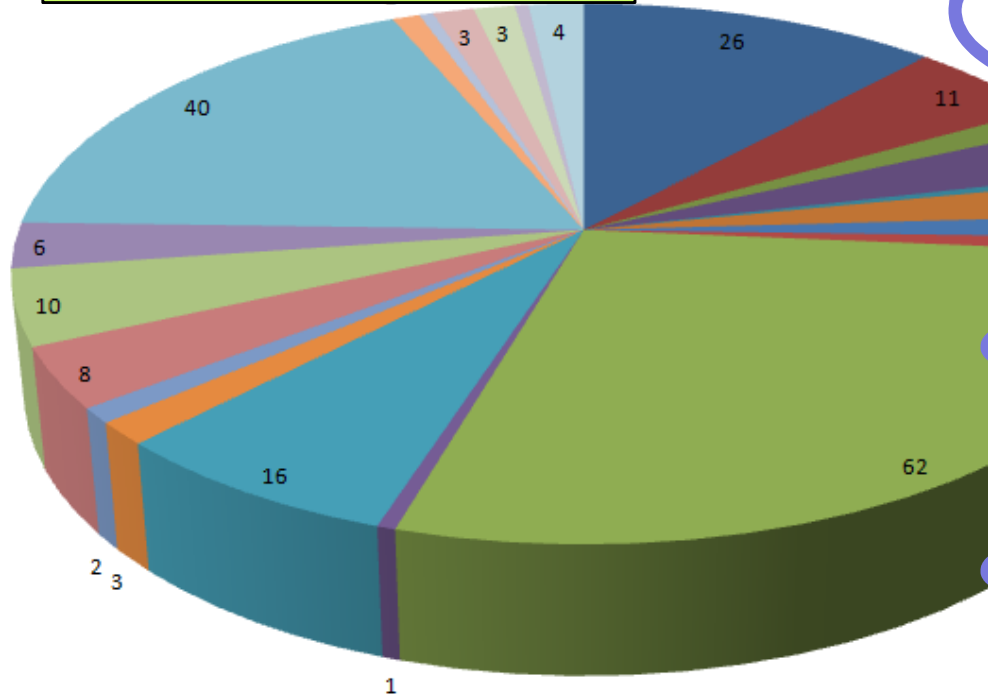


Created in Excel from BizInt Smart Charts

There are lots of problems..

Vocabulary needs to be normalized.

Number of Drugs in Company Pipeline - from 4



- Discontinued
- Discontinued I
- Discontinued II
- Discontinued Preclinical
- Discontinued preregistration
- Discovery
- Launched
- Marketed
- No Development Reported
- No development reported I
- No development reported Preclinical
- Phase 2 Clinical
- Phase 3 Clinical
- Phase I
- Phase II
- Phase III
- Preclinical
- Preregistration
- Pre-registration

Created in Excel from BizInt Smart Charts

Challenges in multi-database reports

| | Common Drug Name | Database | Status | Companies |
|---|------------------|-------------------|-------------------------|--|
| 1 | FP-1039 | Adis R&D Insight | Phase I | Five Prime Therapeutics (Originator) Human Genome Sciences (Licensee) |
| 2 | FP-1039 | IMS R&D Focus | | Five Prime (USA) Human Genome Sciences (USA) |
| 3 | FP-1039 | Thomson Pharma | | Five Prime Therapeutics Inc Human Genome Sciences Inc |
| 4 | FP-1039 | Citeline Pipeline | Phase II | Five Prime Therapeutics Human Genome Sciences |
| 5 | lexatumumab | Thomson Pharma | Phase 2 Clinical | Cambridge Antibody Technology Group plc Human Genome Sciences Inc |
| 6 | lexatumumab | Adis R&D Insight | Discontinued I | Cambridge Antibody Technology (Originator) Human Genome Sciences (Licensee) |
| 7 | lexatumumab | Citeline Pipeline | No Development Reported | Human Genome Sciences AstraZeneca |
| 8 | lexatumumab | IMS R&D Focus | Phase I | Human Genome Sciences (USA) |

1. Multiple Records for the Same Drug

Challenges in multi-database reports

| | Common Drug Name | Database | Status | Companies |
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| 1 | FP-1039 | Adis R&D Insight | Phase I | Five Prime Therapeutics (Originator) Human Genome Sciences (Licensee) |
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2. Conflicting Data for the Same Drug

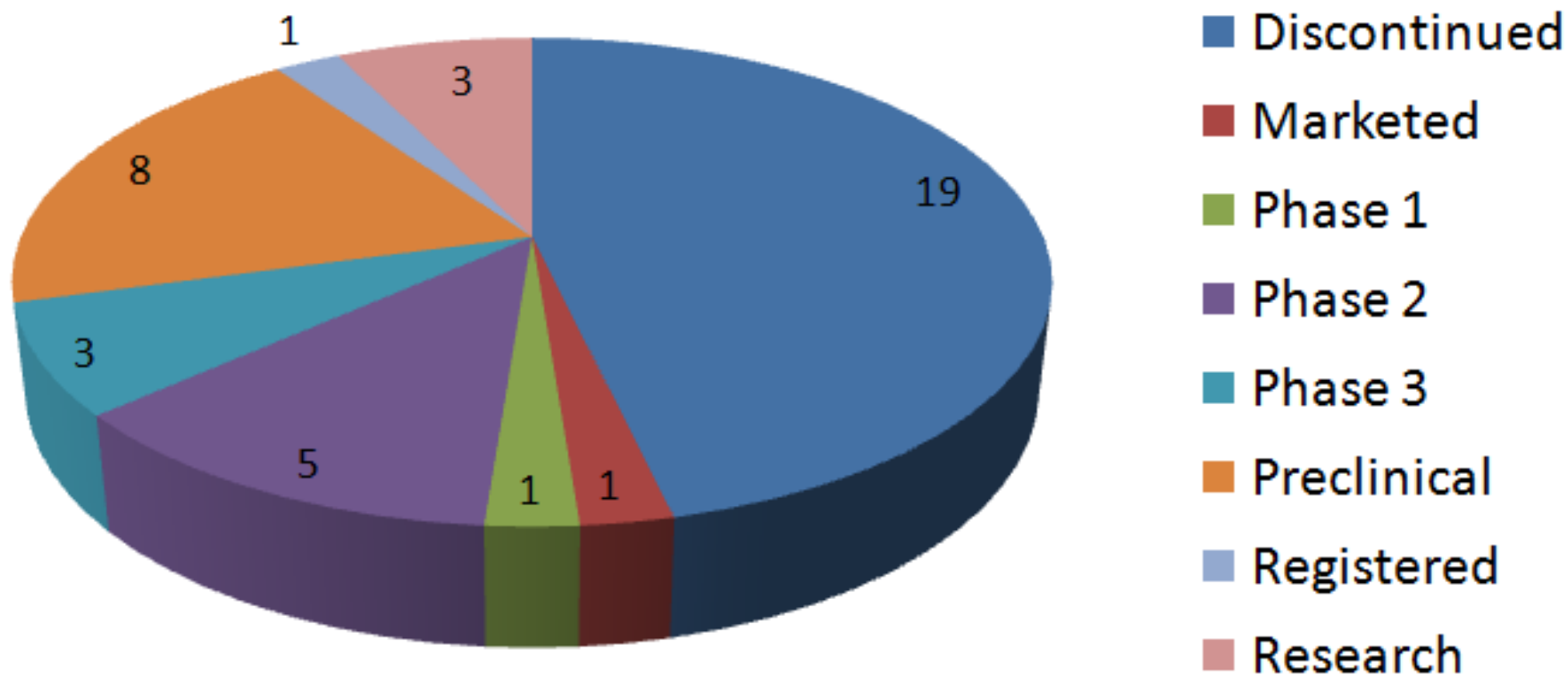
Challenges in multi-database reports

| | Common Drug Name | Database | Status | Companies |
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| 8 | lexatumumab | IMS R&D Focus | Phase I | Human Genome Sciences (USA) |

3. Terminology Variation

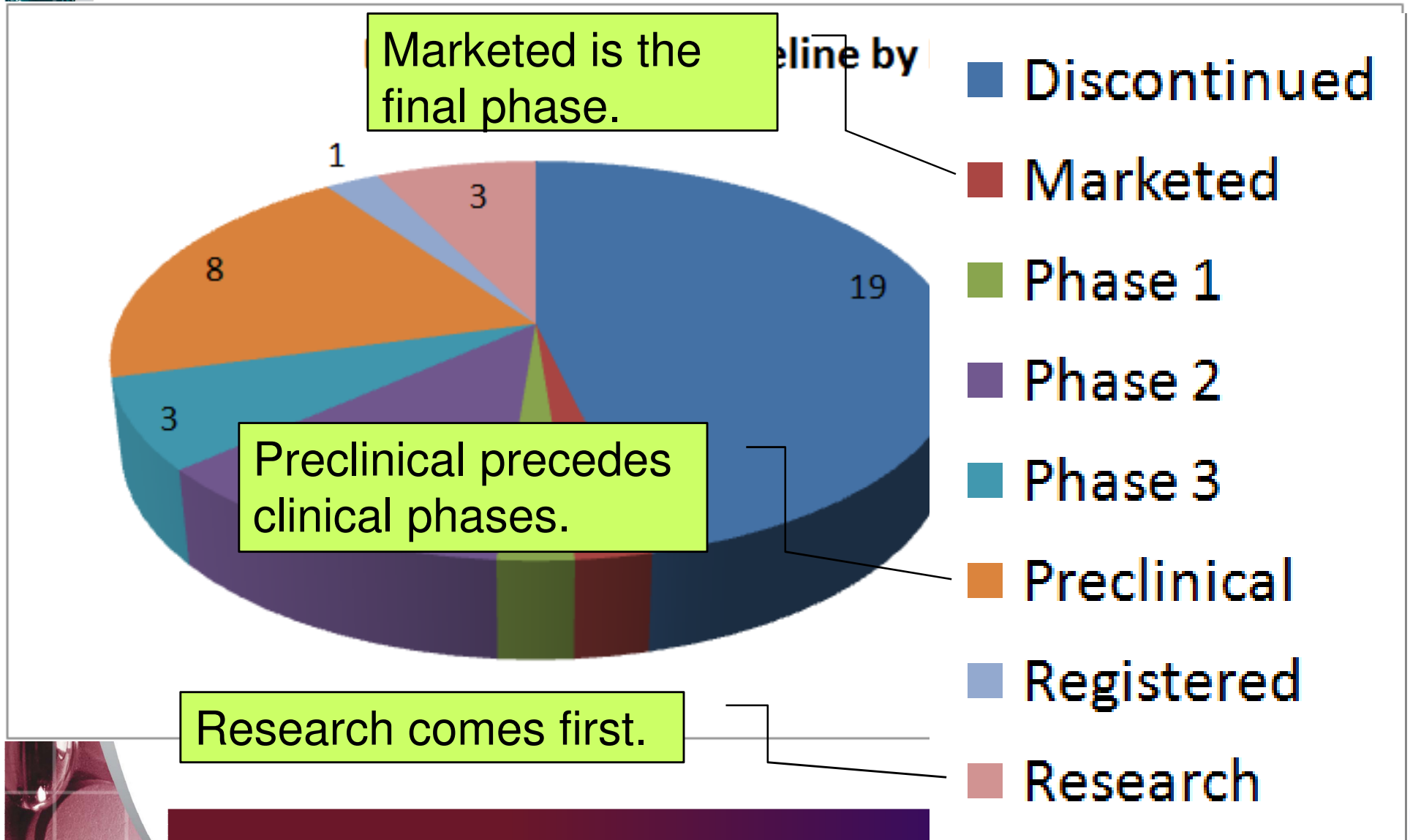
After cleanup and de-duplication...

Drugs in the HGS Pipeline by Phase



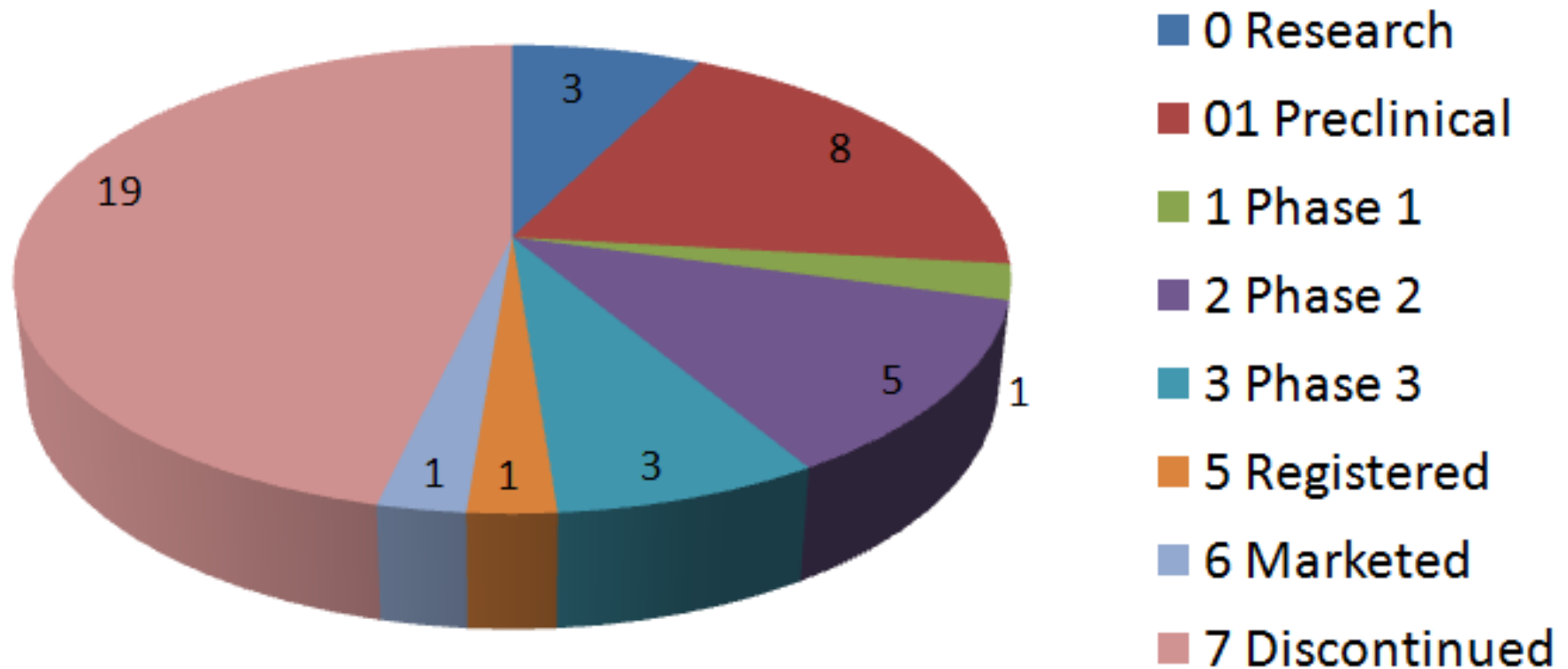
Created in Excel from BizInt Smart
Charts Reference Rows.

But the phases are not ordered by time.

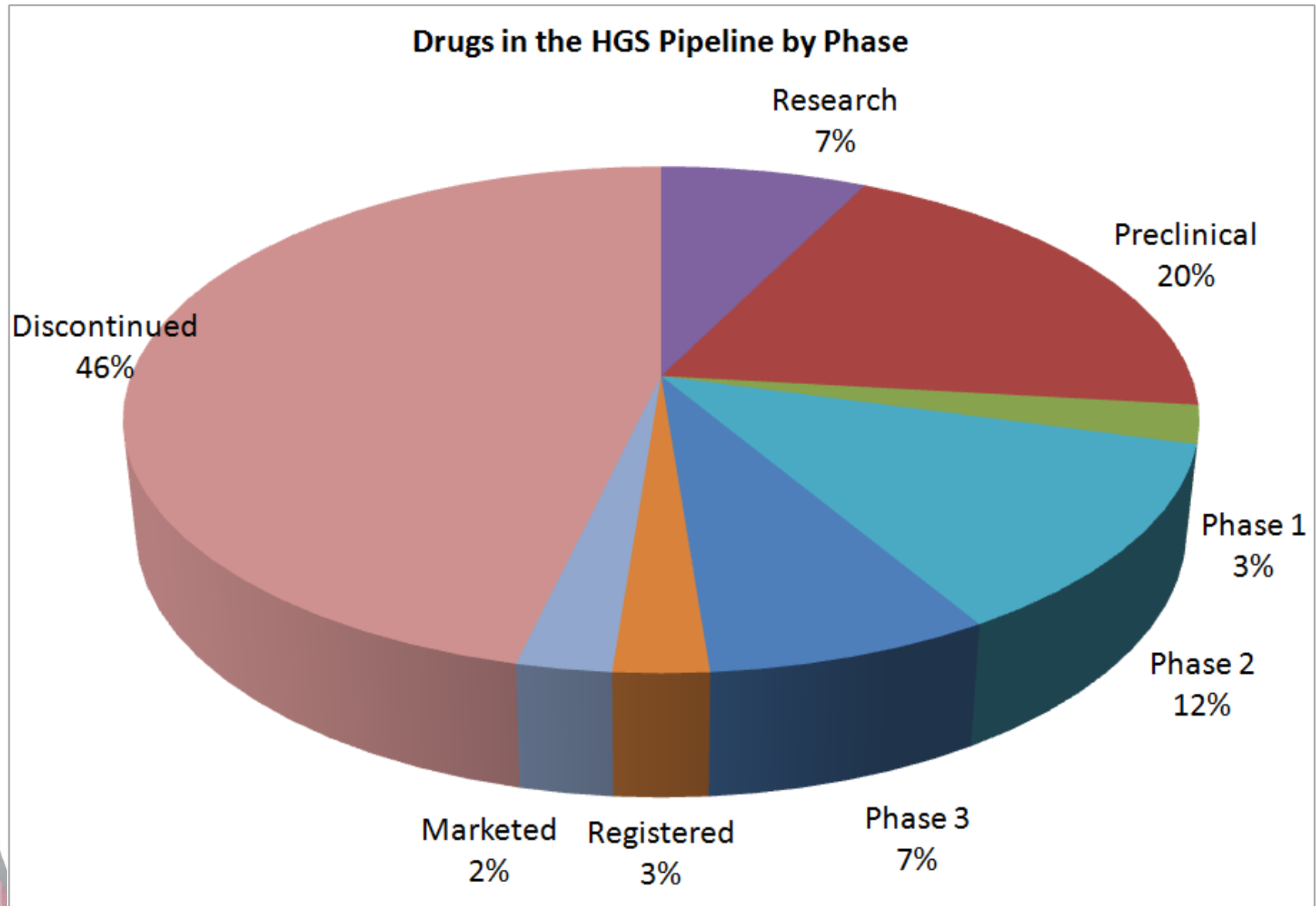


We need to order the phases chronologically

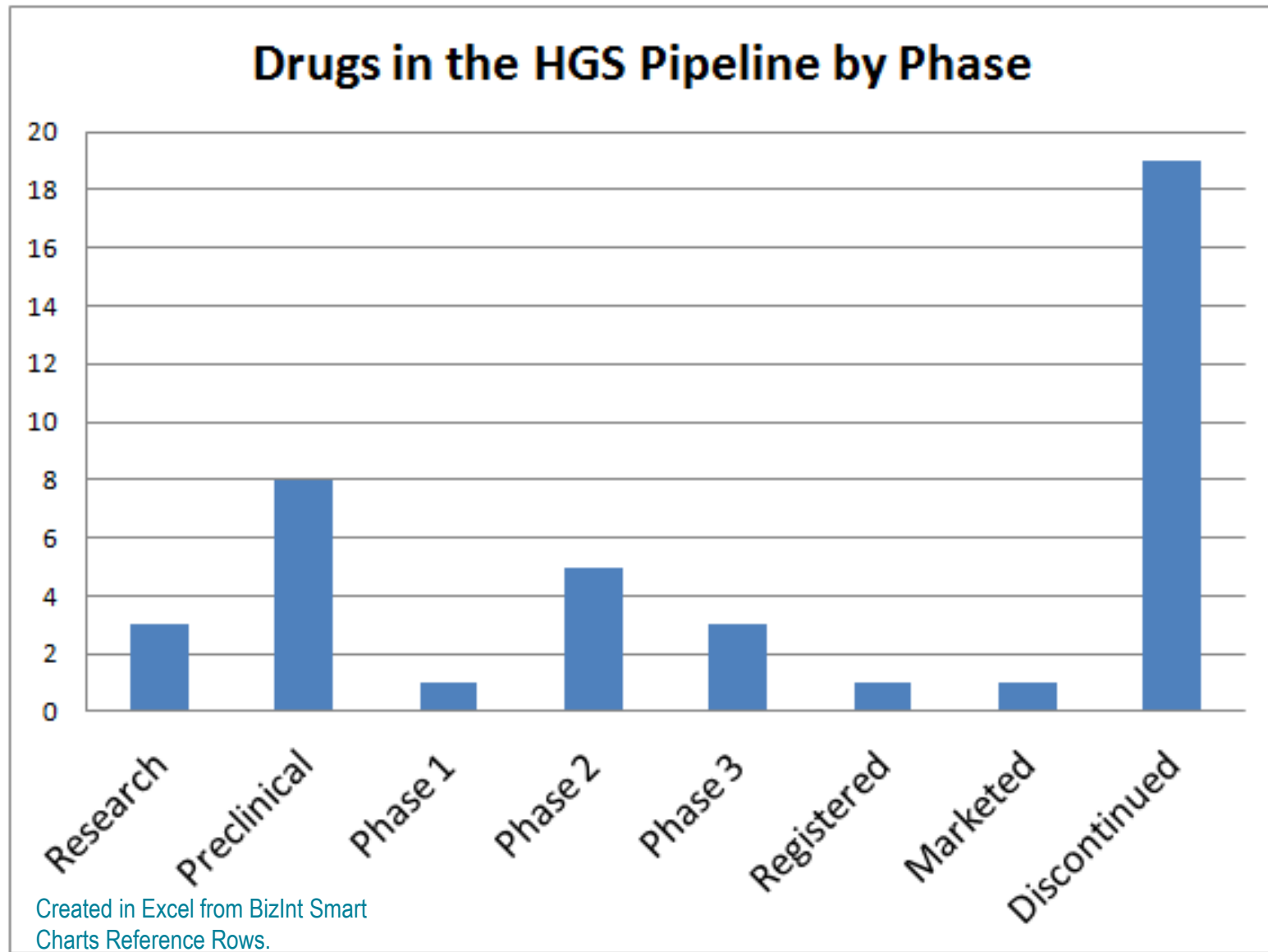
Drugs in the HGS Pipeline by Phase



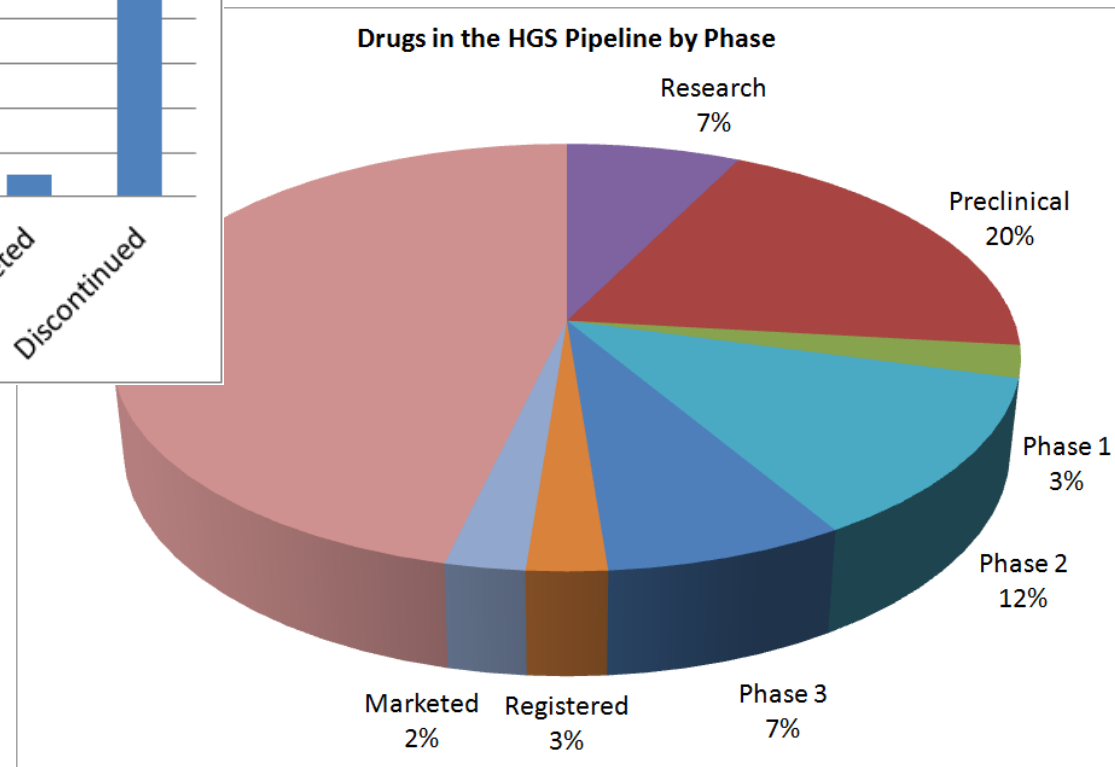
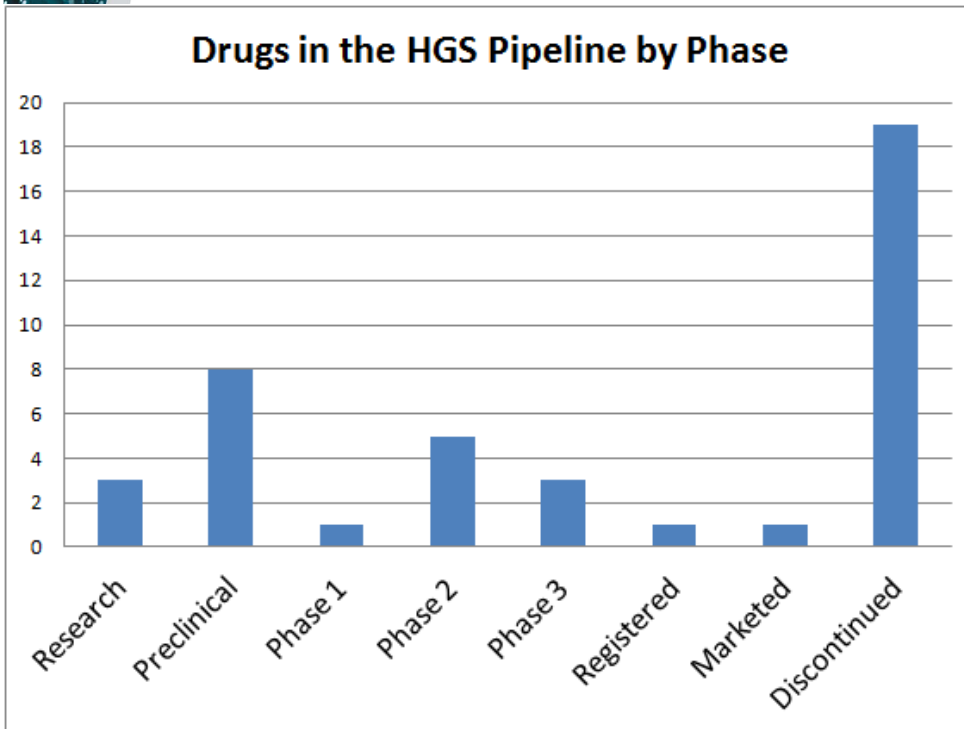
Now we have a meaningful pie graph...



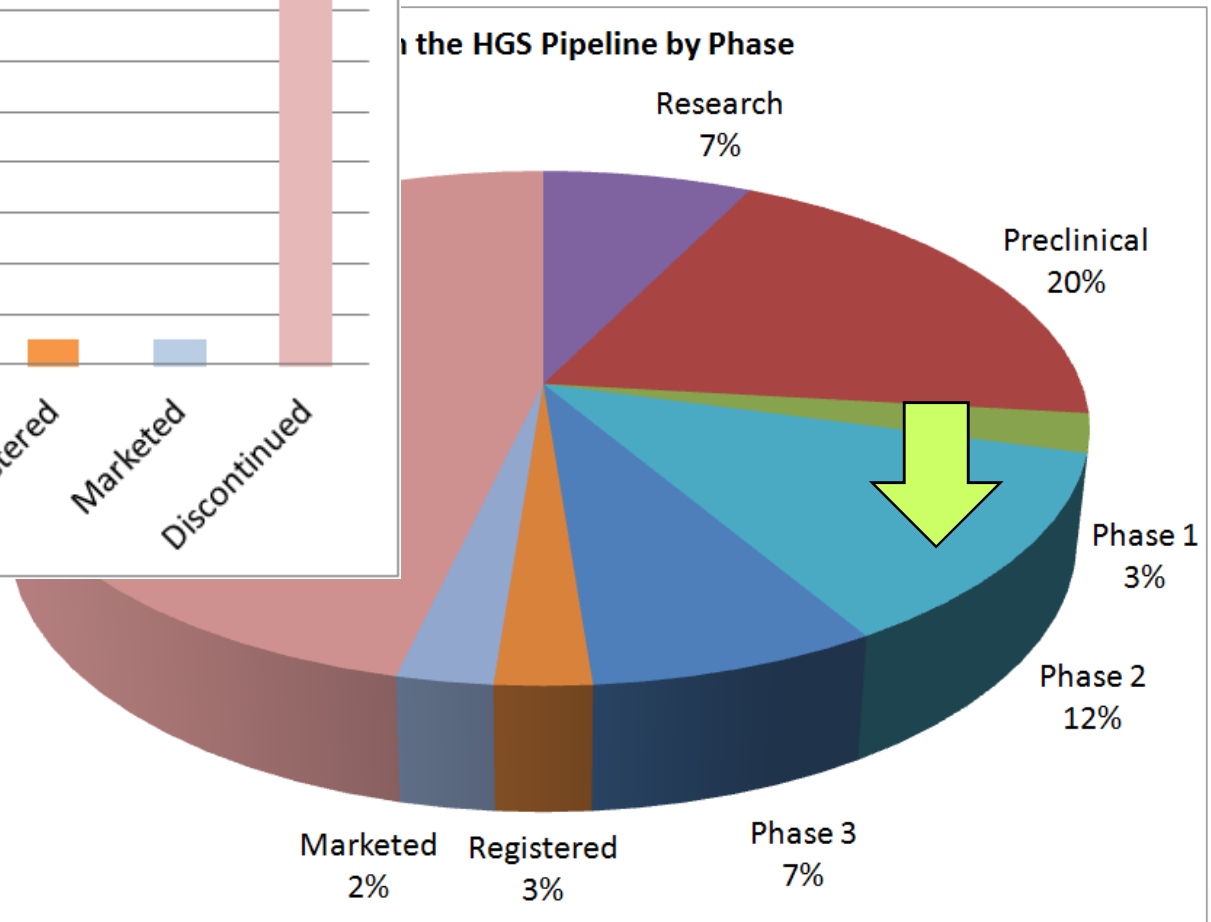
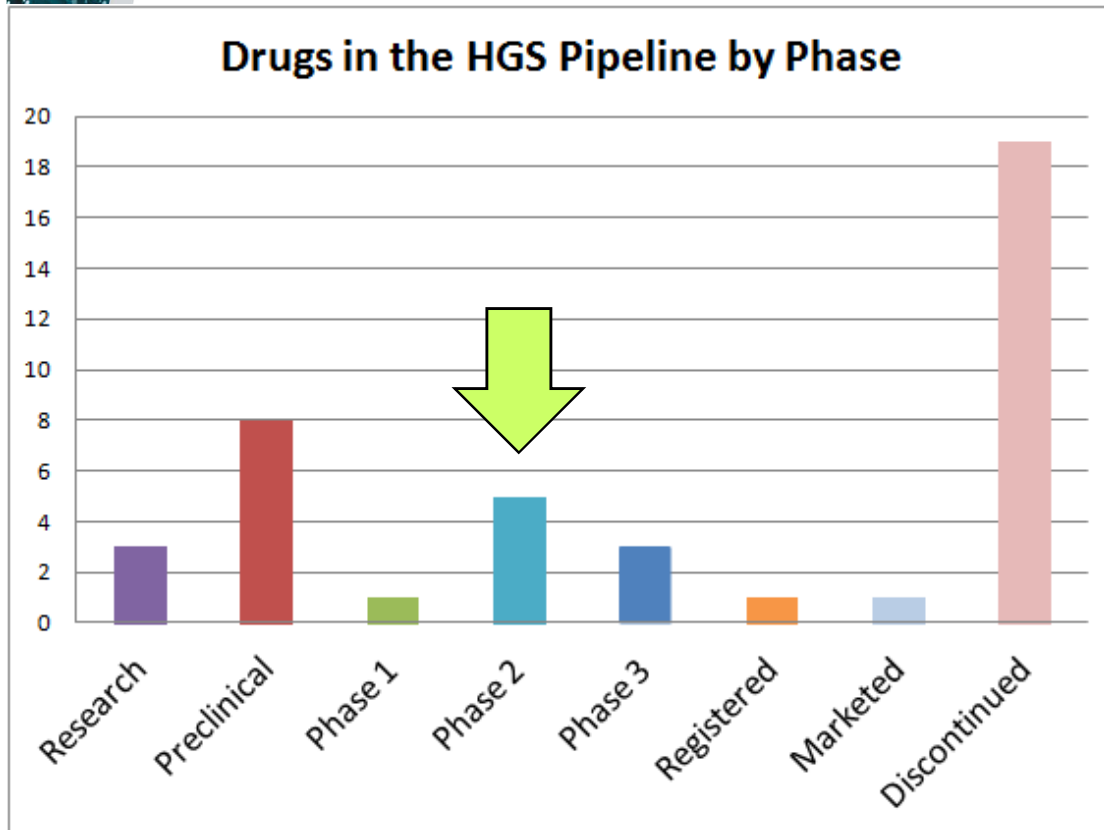
Or we could create a pipeline bar graph...



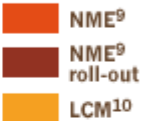
But the colors aren't consistent by phase.



So we apply color palette for phases.



But pipeline bar charts often look like this...

| EXPLORATORY | CONFIRMATORY | | REGISTRATION |
|---|--|--|---|
| | PHASE II | PHASE III | |
| HCD122 Hem. tumors | LBQ707 Solid Tumors | EPO906 Ovarian cancer | Tasigna® (JPN) IM ⁷ res. / intol.CML ³ |
| TKI258 Hem./solid tumors | PKC412 AML ¹ | SOM230 Acromegaly / Cushing's disease | Exjade® (JPN) Chronic iron overload |
| RAF265 Melanoma | LBH589 Hemat. tumors | Glivec® GIST ² adjuvant / CML ³ |  |
| LBY135 Solid tumors | ASA404 Solid tumors | RAD001 Neuroend. tum. | |
| BEZ235 Solid tumors | RAD001 Sol. tumors / breast cancer/ PICT ⁶ | RAD001 RCC ⁴ | |
| AUY922 Solid tumors | SOM230 GEP ¹¹ tumors | Tasigna® GIST ² / newly diagnosed CML ³ / subop. CML ³ | |
| BHQ880 Solid tumors | Glivec® Non-oncology indications | | |
| BGT226 Solid tumors | EPO906 Solid tumors | | |
| LBH589 Hem. & solid tumors | | | |
| Exjade® HH ⁸ | | | |

- 1 Acute myeloid leukemia
- 2 Gastrointestinal stromal tumor
- 3 Chronic myeloid leukemia
- 4 Renal cell carcinoma
- 6 Pancreatic islet cell tumor
- 7 Imatinib
- 8 Hereditary hemochromatosis
- 9 New molecular entity
- 10 Life cycle management
- 11 Gastroenteropancreatic

Source: Novartis website

Each bar/phase is made up of boxes...

| CONFIRMATORY | | REGISTRATION |
|-----------------------------------|--|---|
| PHASE II | PHASE III | |
| LBQ707 Solid Tumors | EPO906 Ovarian cancer | Tasigna IM ⁷ res. / intol.CML ³ |
| PKC412 AML ¹ | SOM230 Acromegaly / Cushing's disease | Exjade® (JPN) Chronic iron overload |
| LBH589 | Glivec® imatinib / imatinib | |

Which represent a drug in that phase.

With a color coding scheme for another aspect of the drug.

- NME⁹
- NME⁹ roll-out
- LCM¹⁰

If there are too many drugs in a phase...

Merck Pipeline February 22, 2013

| Phase II | Phase II | Phase II | Phase III | Phase III |
|---|---|------------------------------------|--|---|
| Allergy, Immunotherapy MK-8237 | CMV Prophylaxis in Transplant Patients, letermovir, MK-8228 | Migraine MK-1602 | Allergy, Grass Pollen ^{1,2} MK-7243 | Herpes Zoster Inactivated VZV vaccine, V212 |
| Alzheimer's Disease MK-8931 ³ | Contraception, Medicated IUS MK-8342 | Overactive Bladder MK-4618 | Allergy, Ragweed ¹ MK-3641 | HPV-related Cancers, V503 HPV vaccine (9 valent) |
| Asthma MK-1029 | Contraception, next generation ring MK-8175A | Pneumoconjugate Vaccine V114 | Atherosclerosis anacetrapib, MK-0859 | Osteoporosis odanacatib, MK-0822 |
| Bacterial Infection MK-7655 | Contraception, next generation ring MK-8342B | Rheumatoid Arthritis MK-4 | | |
| Cancer dalotuzumab, MK-0646 | Hepatitis C MK-5172 | | | |
| Cancer MK-1775 | Hepatitis C MK-8742 | | | |
| Cancer MK-2206 | HIV MK-1439 | | | |
| Cancer dinaciclib, MK-7965 ³ | Insomnia MK-6096 | | | |
| Cancer ridaforolimus, MK-8669 | Melanoma MK-3475 | | | |
| | | | Fertility, corifollitropin alfa injection, MK-8962 (US) | Psoriasis MK-3222 |
| | | | Hepatitis C vaniprevir, MK-7009 ⁵ | Thrombosis vorapaxar, MK-5348 |

The boxes are stacked in multiple columns.

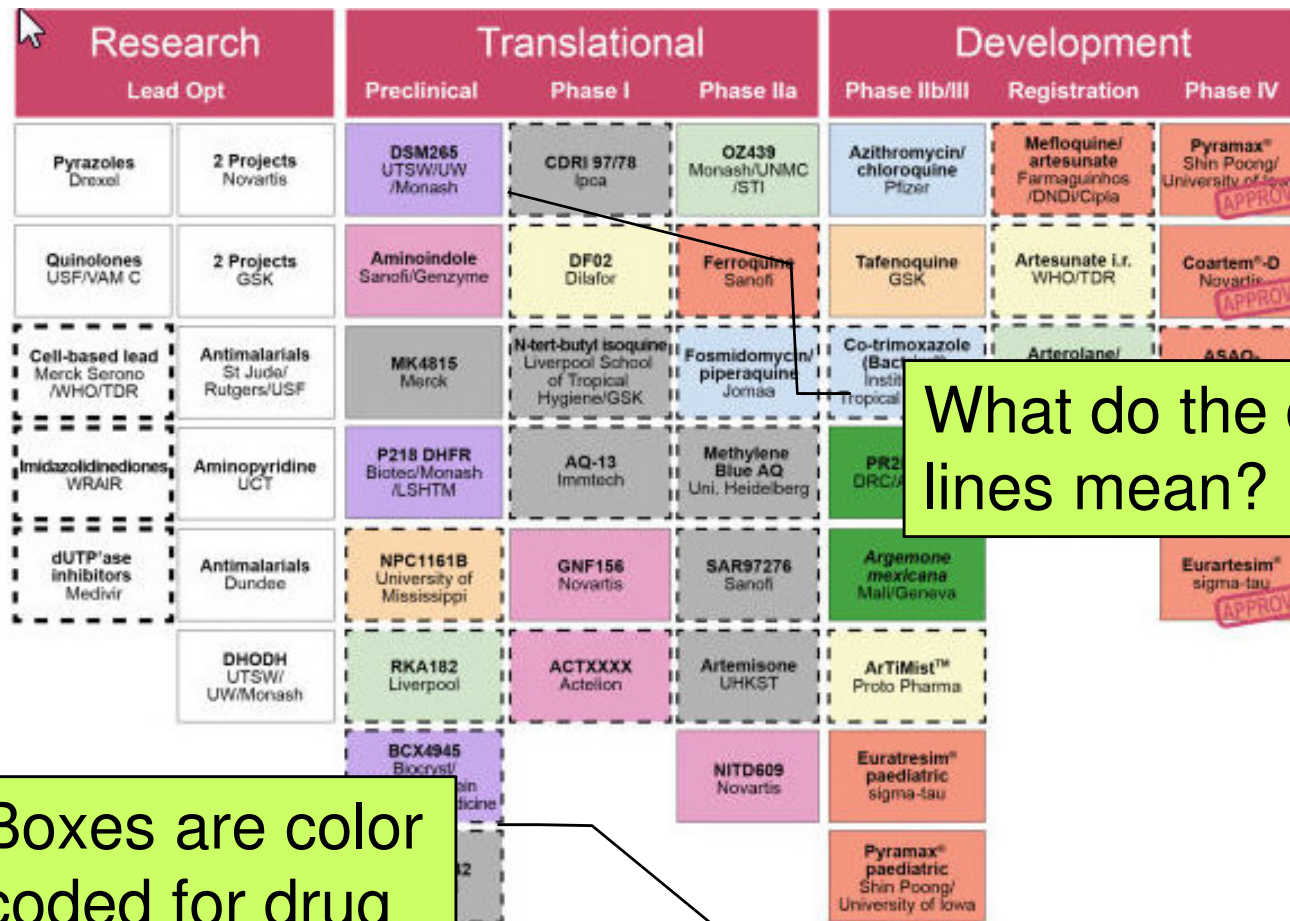
1. North America
2. The Company submitted a New Drug Application for MK-7243 and received FDA approval in November 2011.
3. Phase II/III study
4. In November 2011, Merck received a Complete Response Letter from the FDA for NOMAC/E2 (MK-8175A). The Company is conducting an additional clinical study requested by the FDA and plans to update the application in the future.
5. For development in Japan only.

➔ Moved forward since last pipeline update.

P Public



Many dimensions are overlaid...



What do the dashed lines mean?

Boxes are color coded for drug "features".

APPROVED means approved by a Stringent Regulatory Authority or by WHO prequalification

- ACTs
- Antibiotics
- Cell-Based Mechanisms
- Endoperoxides
- P. vivax*
- Natural Products
- Severe Malaria
- Molecular Mechanisms
- On Hold

Source: Anthony et al. Malaria Journal

These are not standard bar charts!

| Research | Lead Opt | Translational | | | Development | | | |
|-----------------------|--------------------------|--|--|--|---|---|--|---|
| | | Preclinical | Phase I | Phase IIa | Phase IIb/III | Registration | Phase IV | |
| Pyrazoles | Droxal | 2 Projects Novartis | DSM265 UTSW/UW /Monash | CDRI 97/78 Ipsa | OZ439 Monash/UMC /STI | Azithromycin/ chloroquine Pfizer | Mefloquine/ artesunate Farnagurines (DND/Cipla) | Pyramax® Shin Poong/ University of Seoul APPROVED |
| Quinolones | USFVAM C | 2 Projects GSK | Aminoindole Sanofi/Genzyme | DF02 Diflor | Ferroquine Sanofi | Tafenoquine GSK | Artesunate I.r. WHO/TDR | Coartem®-D Novartis APPROVED |
| Cell-based lead | Merck Serono /WHO/TDR | Antimalarials St Jude/ Rutgers/USF | MK4815 Merck | N-tert-butyl isoquine Liverpool School of Tropical Hygiene/GSK | Fosmidomycin piperazine Jornaa | Co-trimoxazole (Bactrim®) Institute of Tropical Medicine | Arterolane piperazine Ranbaxy | ASAQ- Winthrop Sanofi-Genzyme APPROVED |
| Imidazolidinones | WRAIR | Aminopyridine UCT | P218 DHFR Biotech/Monash /LSHTM | AQ-13 Immitch | Methylene Blue AQ Uni. Heidelberg | PR289CT DRC/Antwerp | ARCO® Naphthoquine/ artemisinin Kunming | Artesunate for injection Celis APPROVED |
| dUTPase inhibitors | Medivir | Antimalarials Dundee | NPC1161B University of Mississippi | GNF156 Novartis | SAR97276 Sanofi | Argemone mexicana Mati/Genève | Eurartesim® sigma-tau APPROVED | |
| DHODH | UTSW/ UW/Mer | | RKA182 Liverpool | ACTXXXX Actelion | Artemisone LHKST | ArTImis™ Pavia/Shaw | | |

Merck Pipeline February 22, 2013

| Phase II | Phase II | Phase II | Phase III | Phase III |
|--|---|---|--|--|
| Allergy, Immunotherapy ¹ MK-8237 | CMV Prophylaxis in Transplant Patients, Icternovir, MK-8228 | Migraine MK-1602 | Allergy, Grass Pollen ^{1,2} MK-7243 | Herpes Zoster Inactivated VZV vaccine, VZ12 |
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| Bacterial Infection MK-7655 | Contraception, next generation ring MK-8342B | Rheumatoid Arthritis MK-8457 | Clostridium difficile Infection actoxumab/bezlotoxumab, MK-3415A | Parkinson's Disease preladenedin, MK-3814 |
| Cancer dalotuzumab, MK-0646 | Hepatitis C MK-5172 | 1. North American rights. 2. The Company has submitted a BLA for MK-7243 and now awaits acceptance for review by the FDA. 3. Phase III/III adaptive design. 4. In November 2011, Merck received a Complete Response Letter from the FDA for NOMAC/E2 (MK-8175A). The Company is conducting an additional clinical study requested by the FDA and plans to update the application in the future. 5. For development in Japan only. | Contraception NOMAC E2 MK-8175A (US) ⁴ | Pediatric Hexavalent Combination Vaccine, V419 |
| Cancer MK-1775 | Hepatitis C MK-8742 | | Diabetes Mellitus MK-3102 | Platinum-resistant Ovarian Cancer, vintafolide, MK-8109 (US) |
| Cancer MK-2206 | HIV MK-1439 | | Fertility, corifollitropin alfa injection, MK-8962 (US) | Psoriasis MK-3222 |
| Cancer dinaciclib, MK-7985 ³ | Insomnia MK-8096 | | Hepatitis C vaniprevir, MK-7009 ⁵ | Thrombosis vorapaxar, MK-5348 |
| Cancer ridaforolimus, MK-8669 | Melanoma MK-3475 | | | |



➔ Moved forward since last pipeline update.

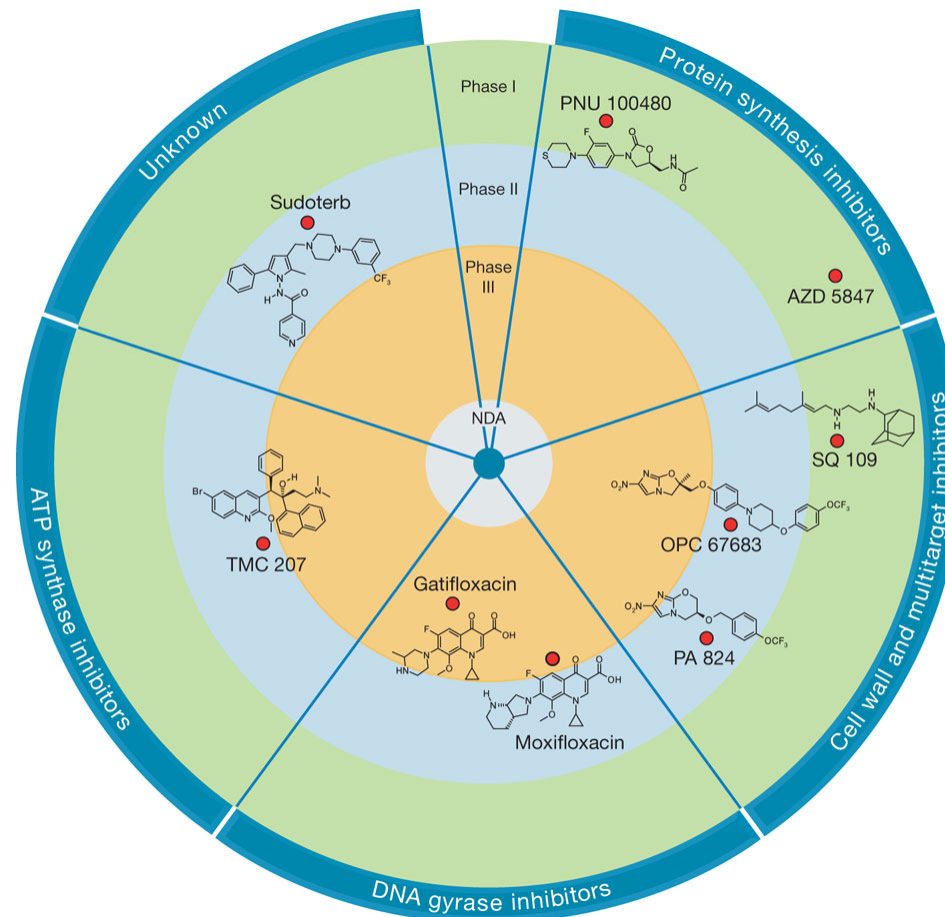


| EXPLORATORY | CONFIRMATORY | | REGISTRATION |
|----------------------------------|---|---|---|
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- 1 Acute myeloid leukemia
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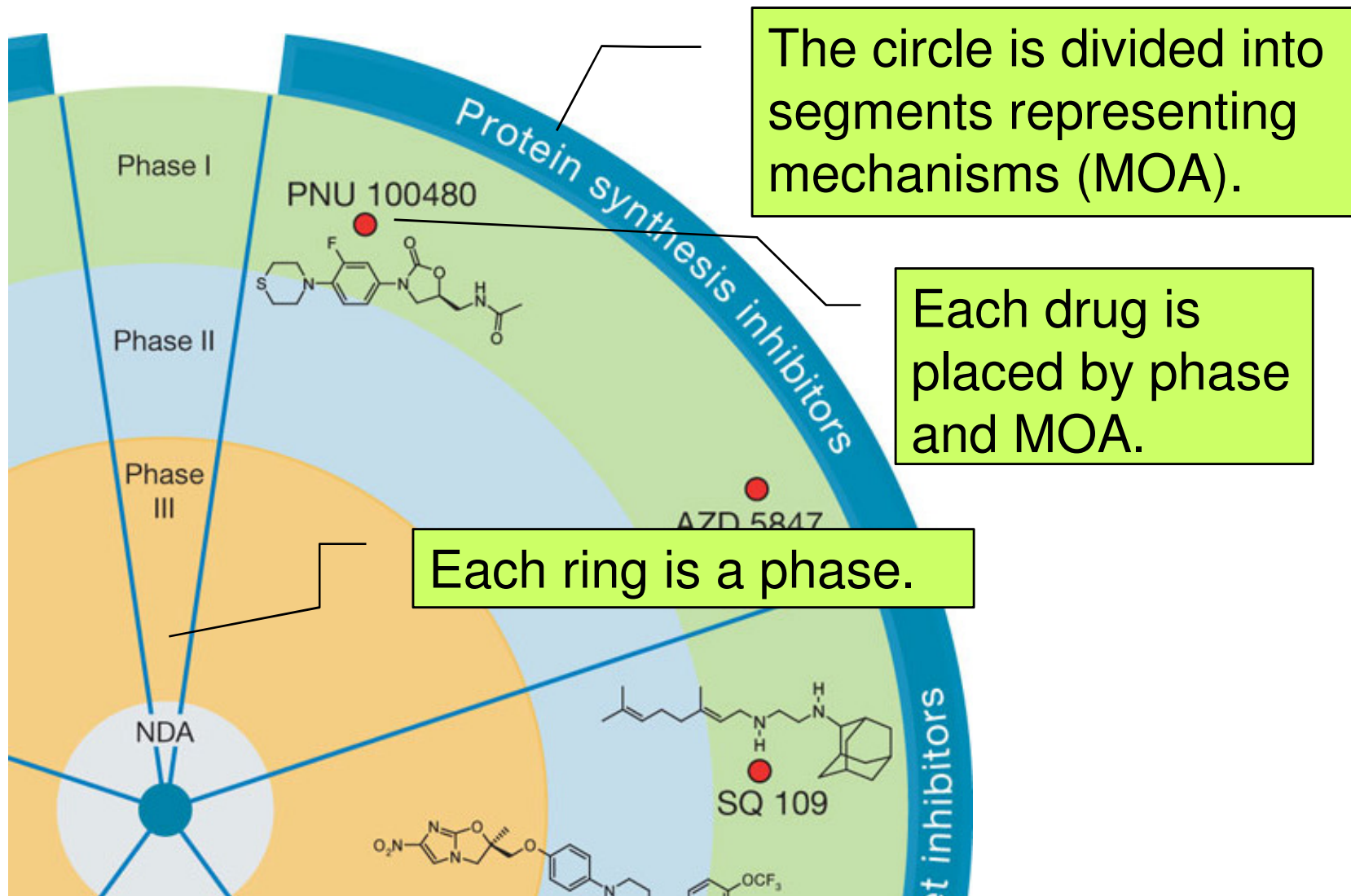
Here's a "bulls-eye" pipeline visualization...

A bull's-eye representation of the current clinical pipeline for TB.



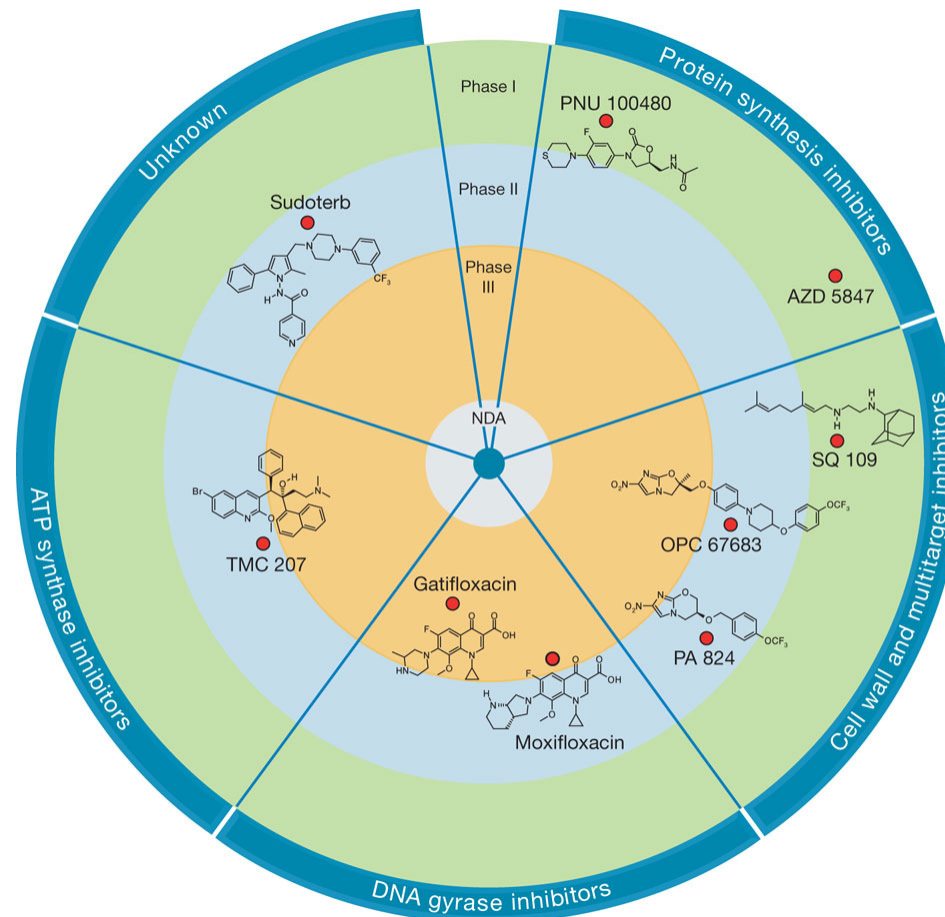
A Koul et al. *Nature* 469, 483-490 (2011) doi:10.1038/nature09657

Features of a pipeline “bulls-eye”



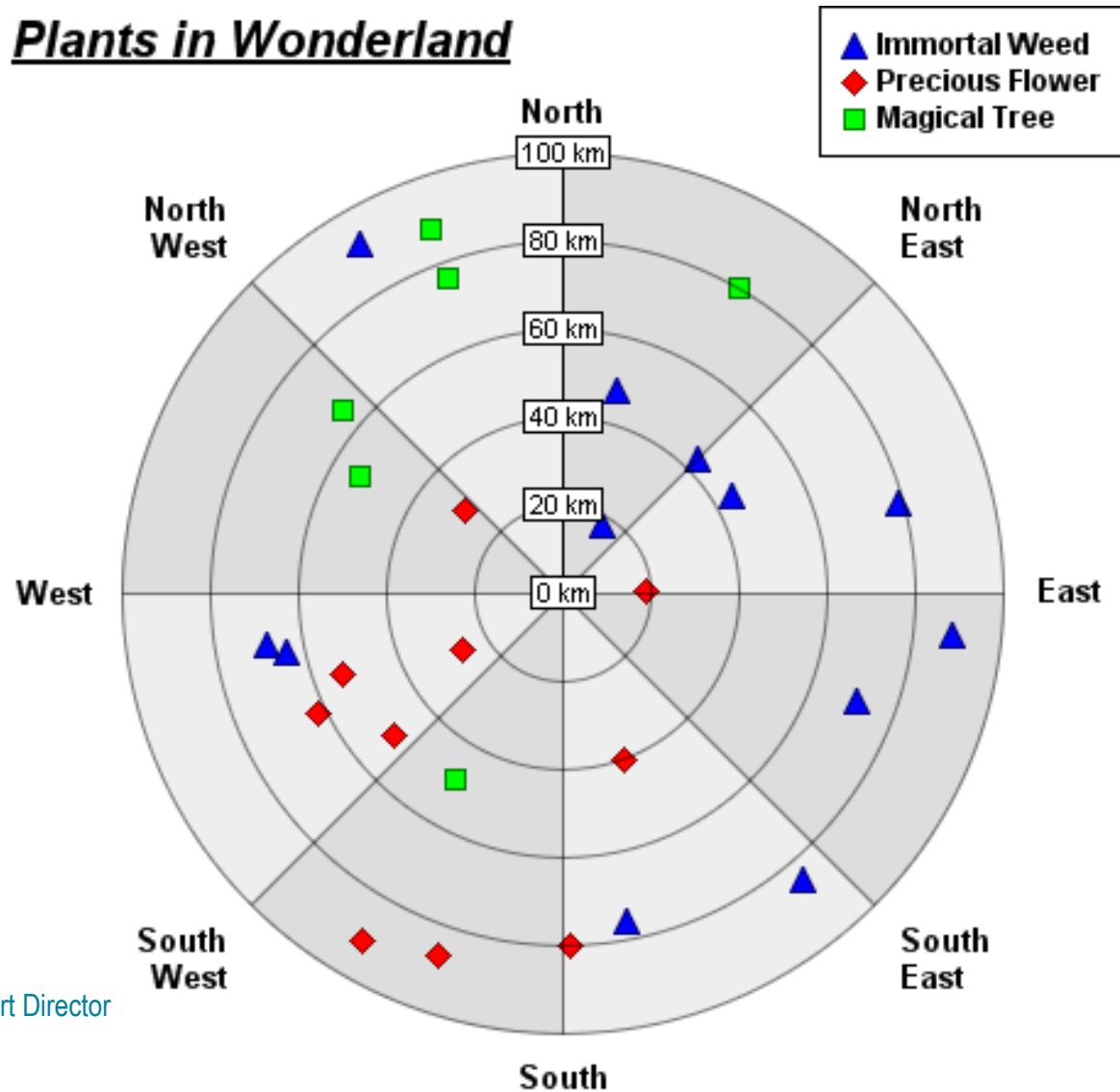
This is not a standard visualization!

A bull's-eye representation of the current clinical pipeline for TB.



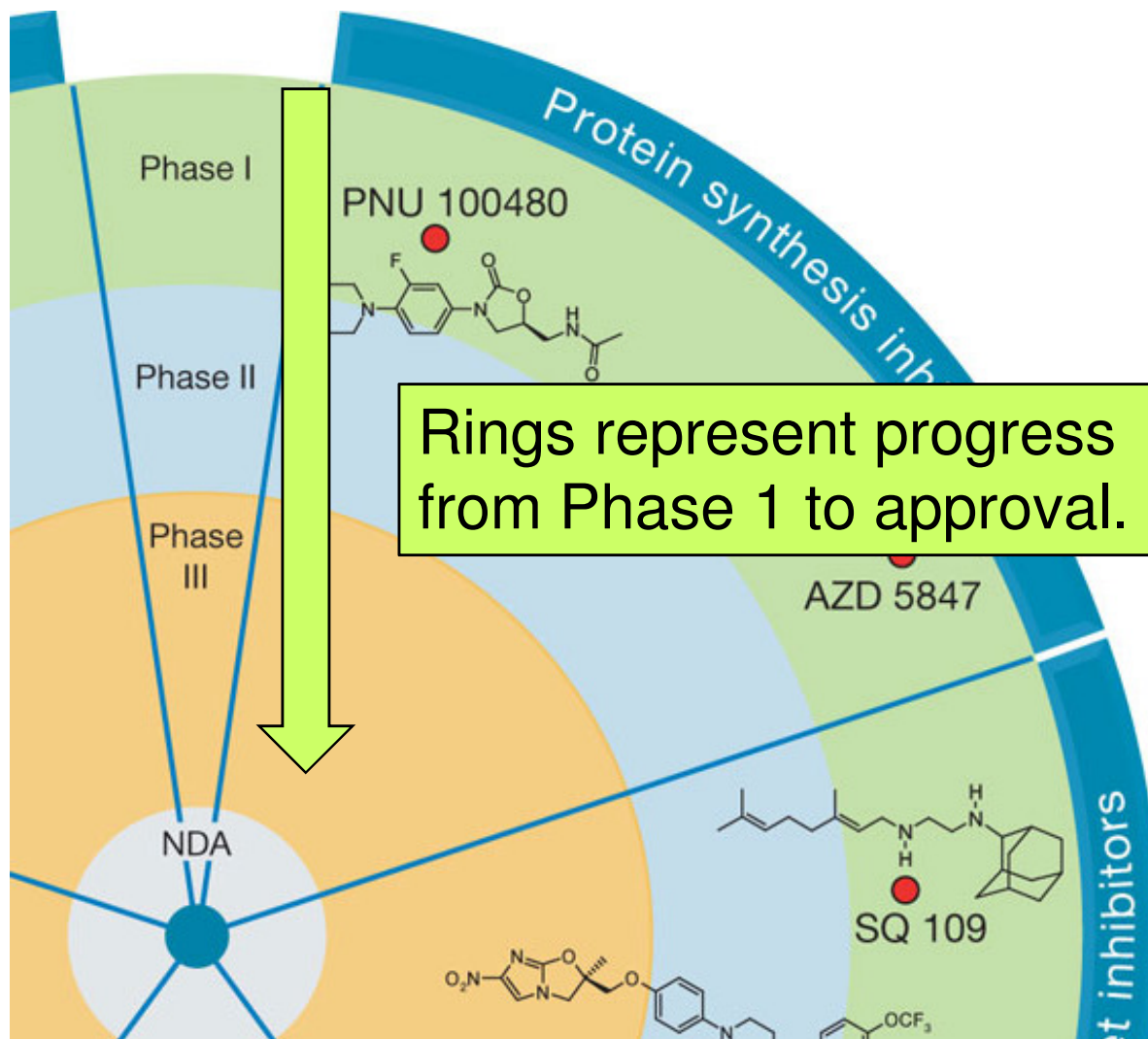
It has features of a polar scatter chart.

Plants in Wonderland

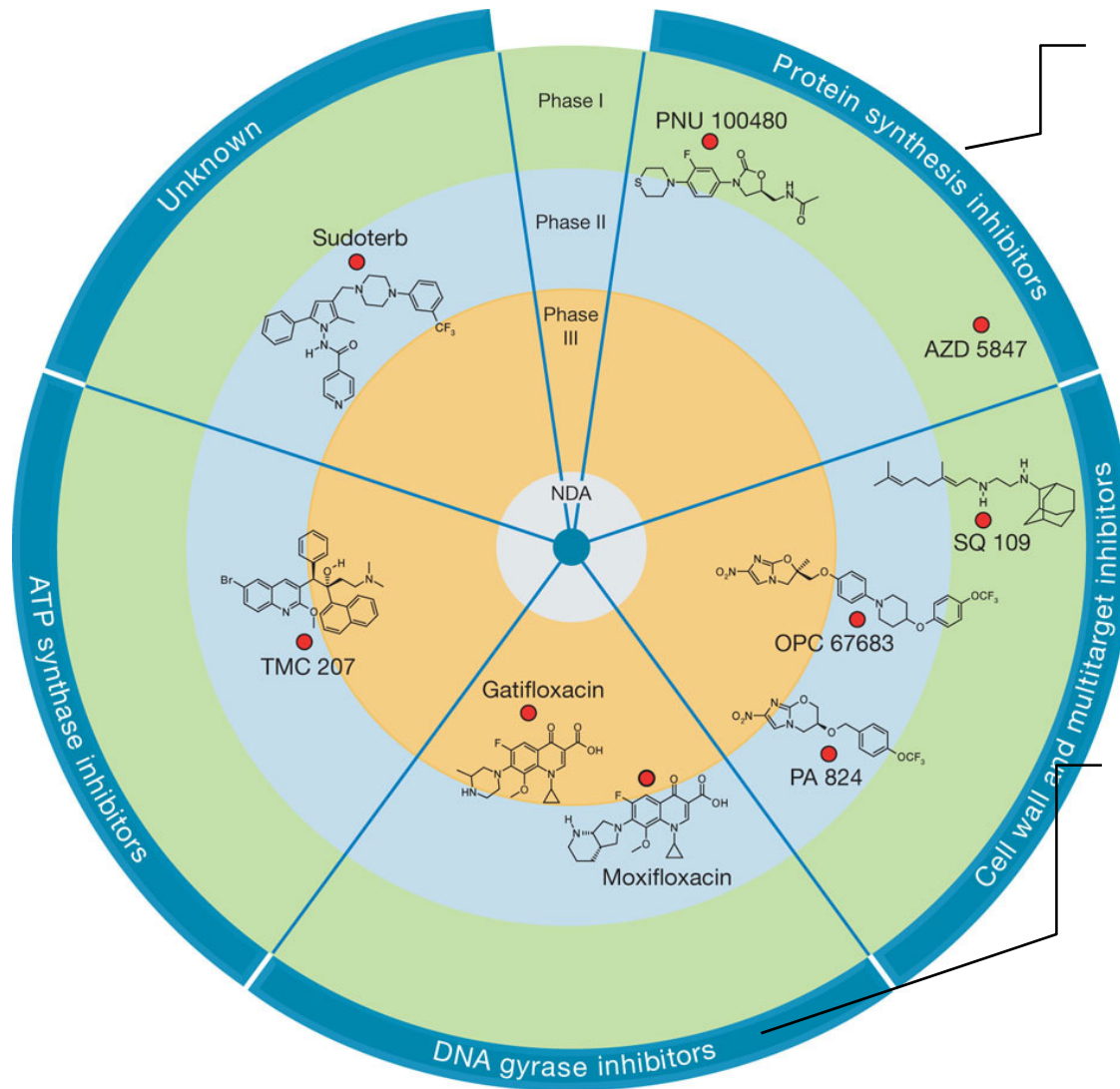


Sample from Chart Director
chart library.

The radial values are related to time.



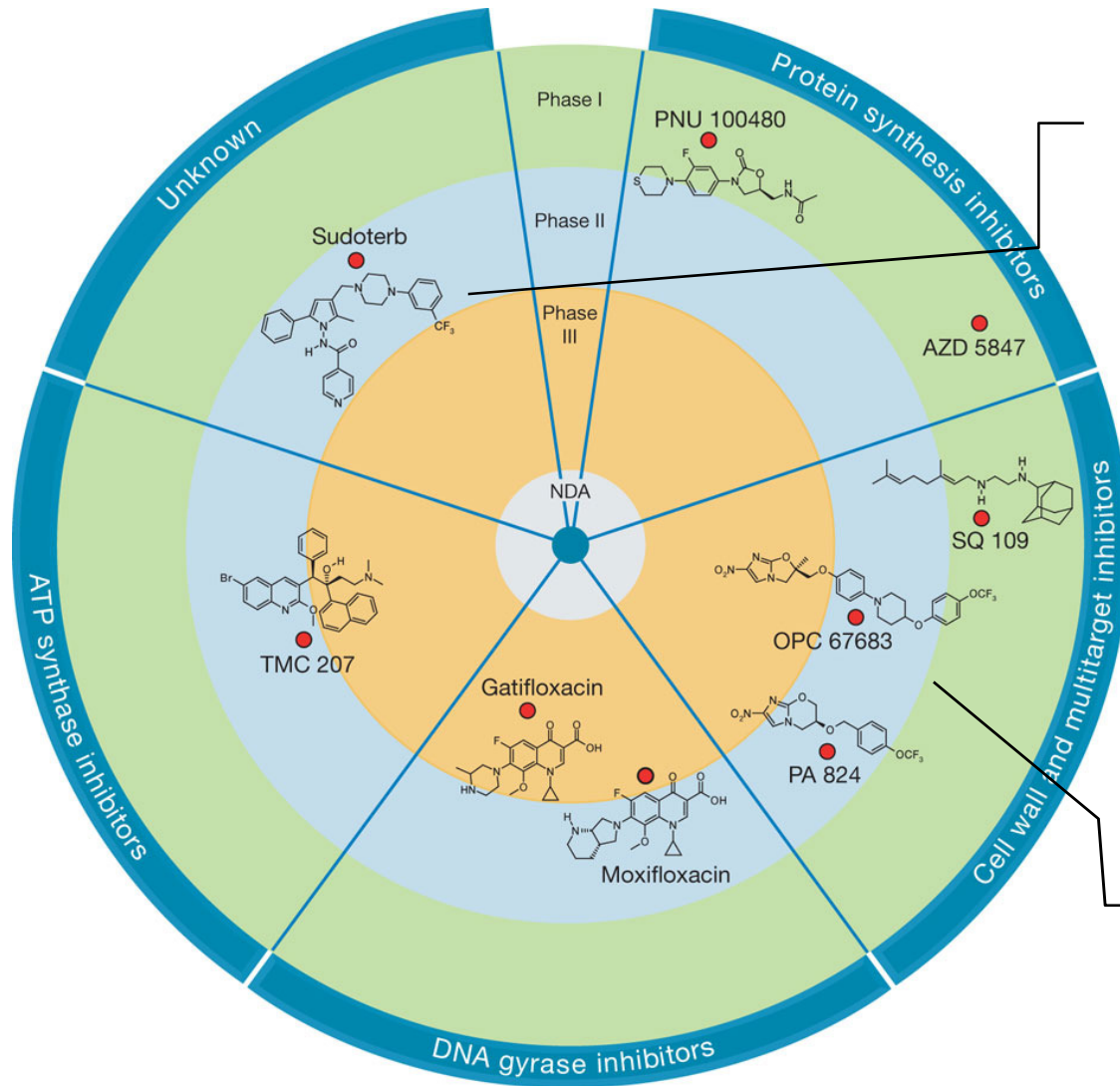
But the segments are like a pie graph...



Each segment is a different MOA.

And there is no meaning to the order of the segments.

Except the segments are the same size...

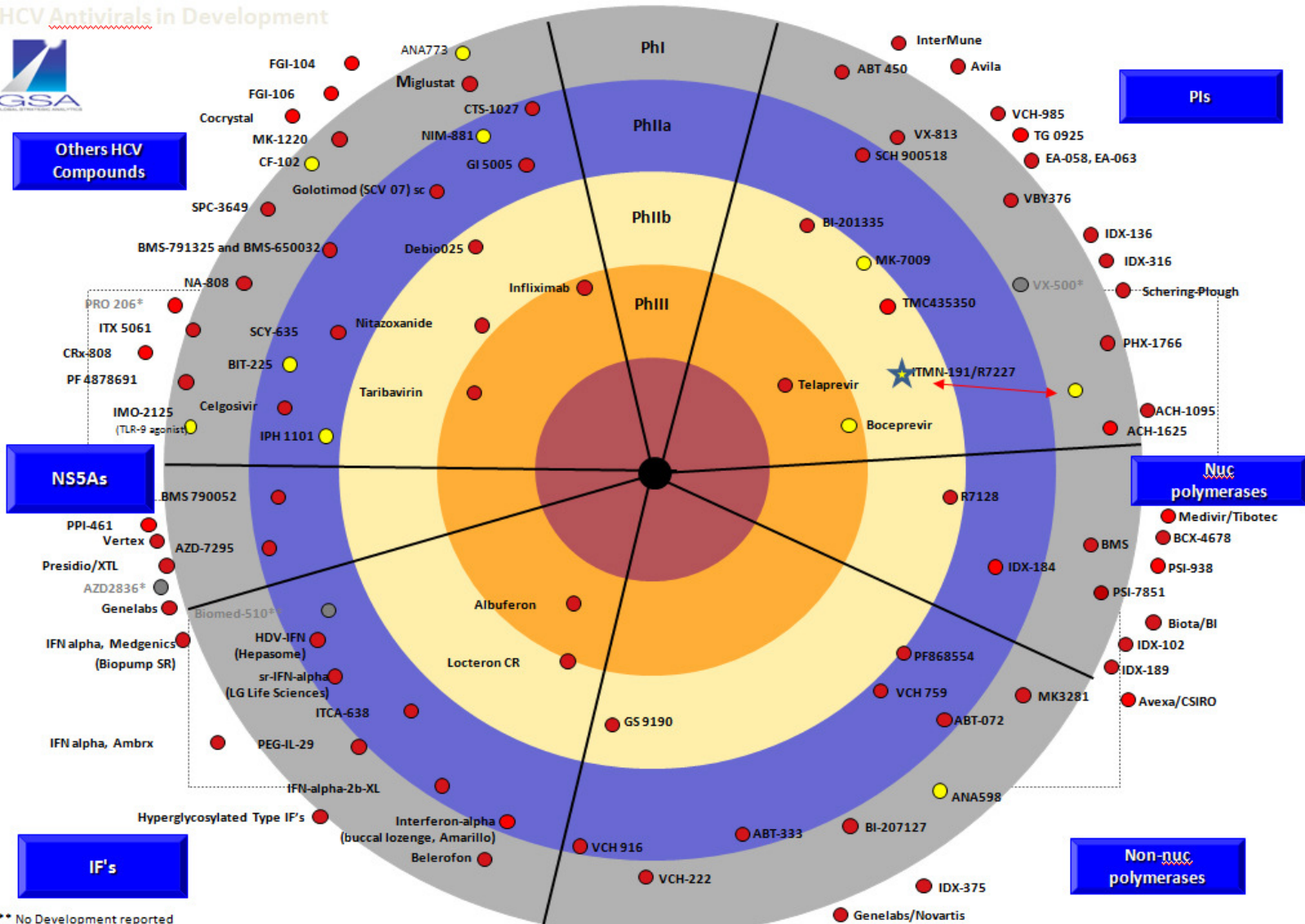


Even though there is 1 drug for this MOA.

And 3 for this MOA.

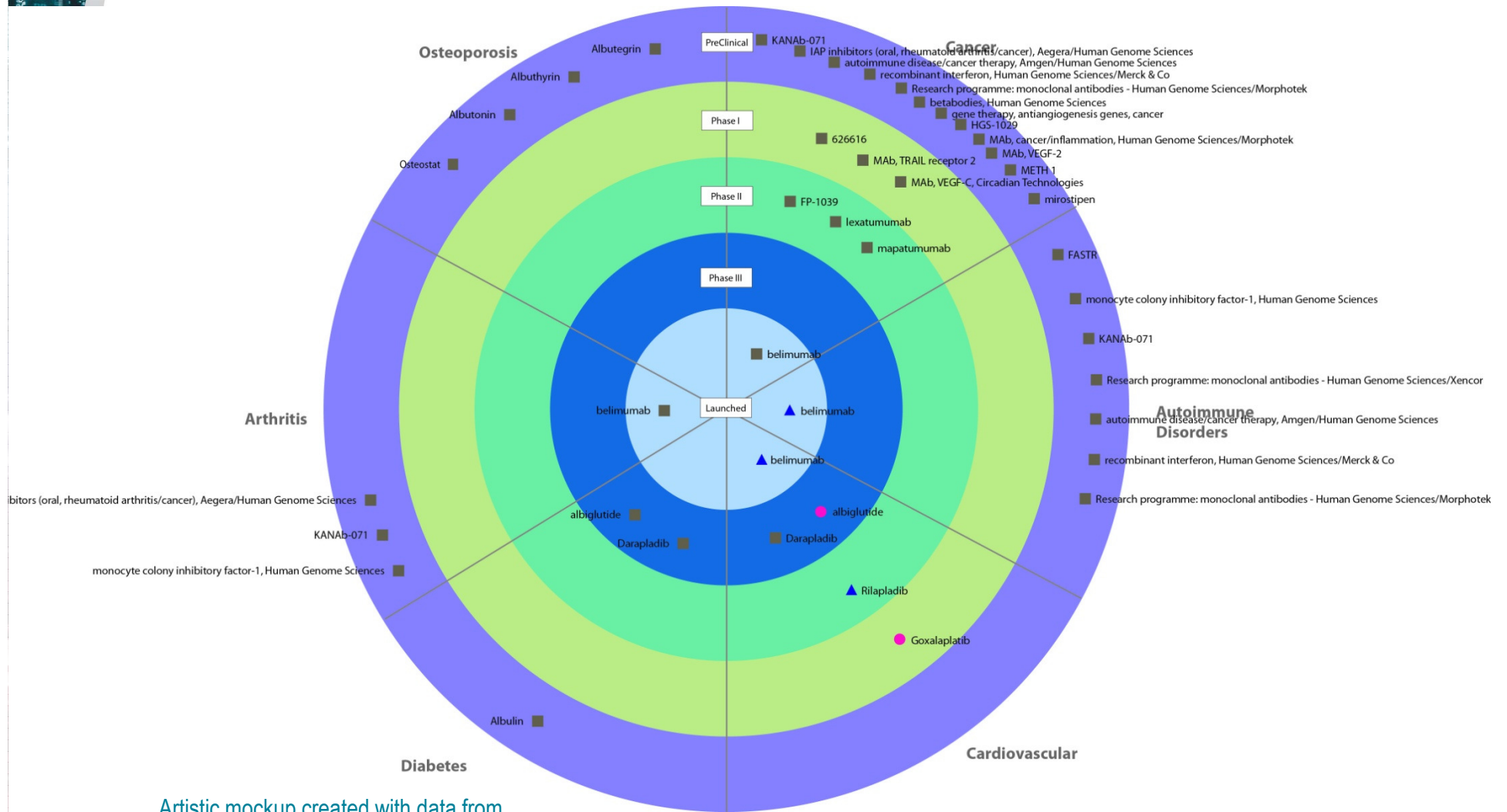
In this bulls-eye, segment sizes vary...

HCV Antivirals in Development



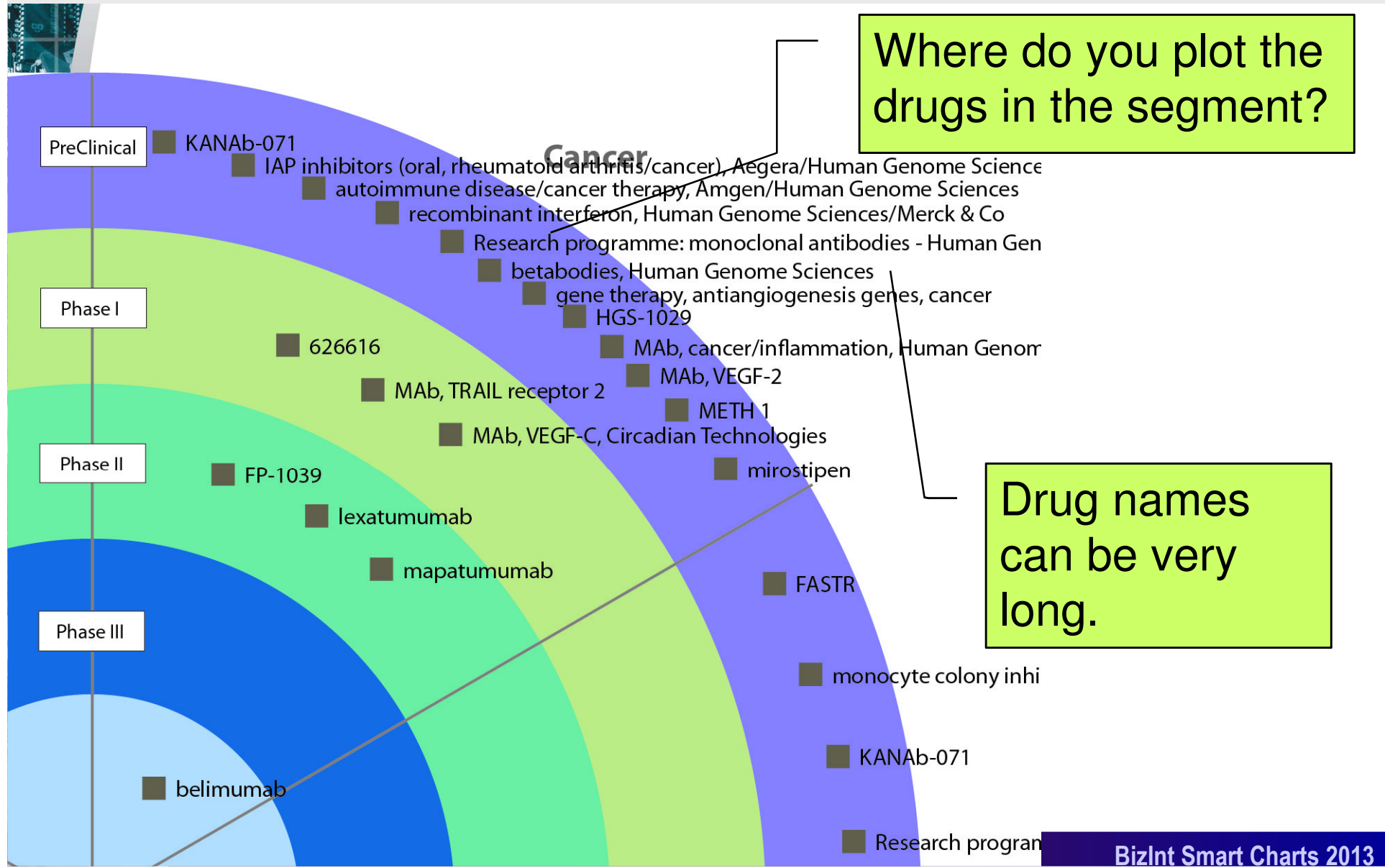
** No Development reported
 * Discontinued (VX-500: 1 March 2009 (IDDB), Adigis, AZD2836: 29 Jan 2009 (IDDB), ANA773: 5 June 2009 (IDDB), PRO 206: 8 June 2009 (IDDB))
 Sources: GBI Analysis (12 June 2009), Pipeline Sources, Company Press Releases, Reuters Knowledge Analyst Reports

Some issues creating pipeline bulls-eyes...

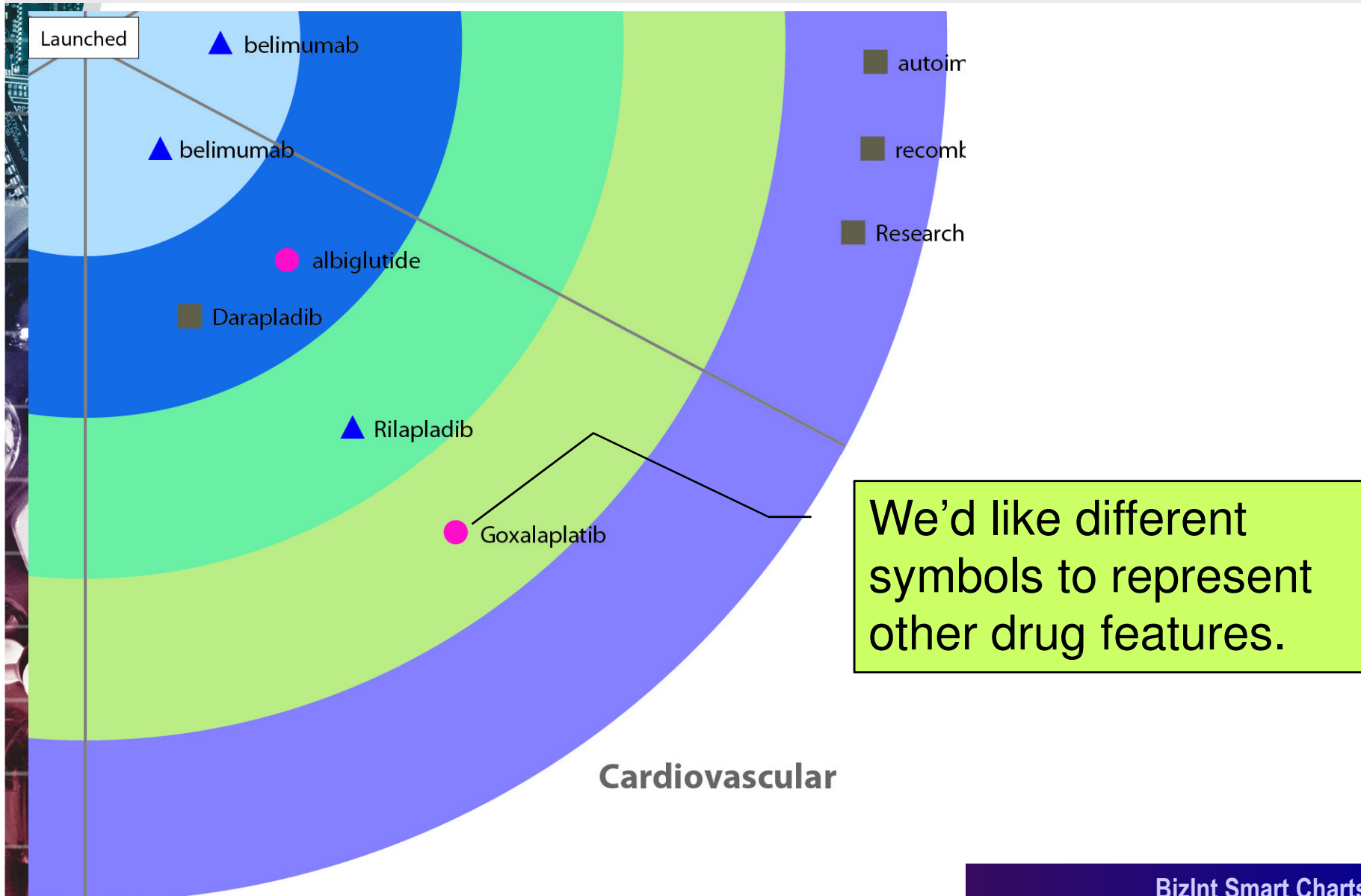


Artistic mockup created with data from BizInt Smart Charts Reference Rows.

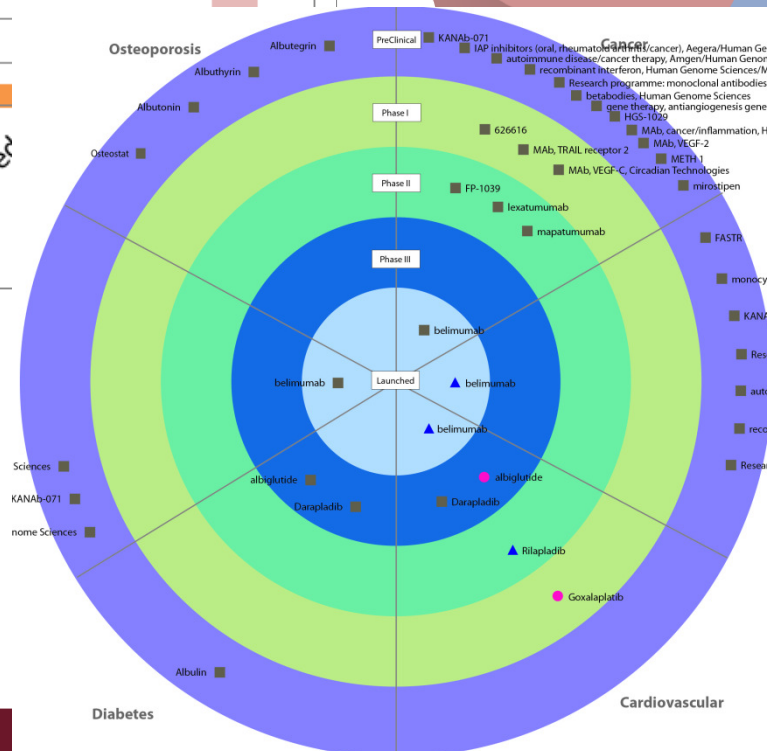
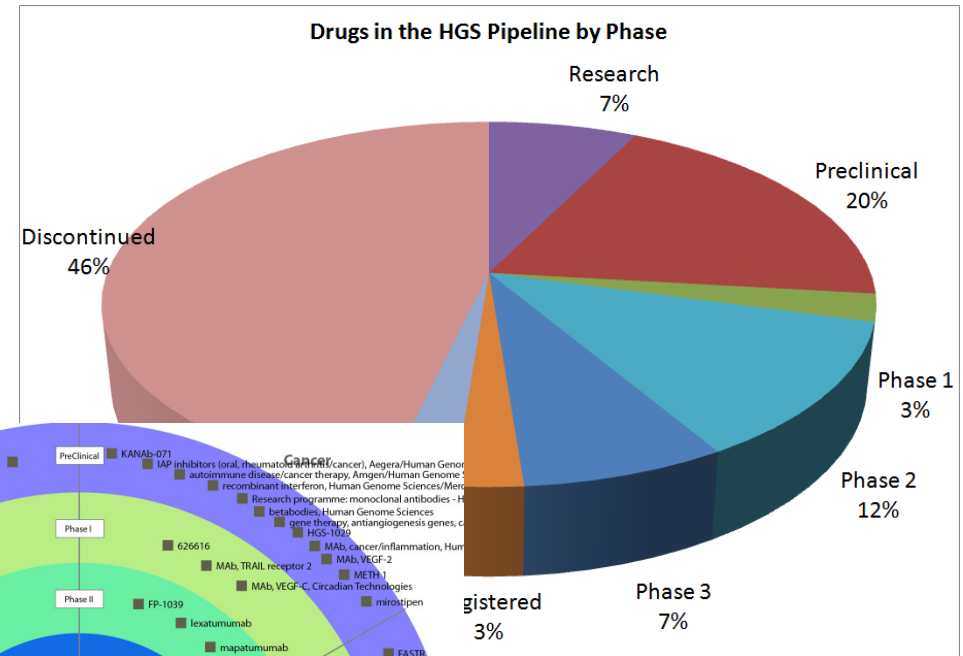
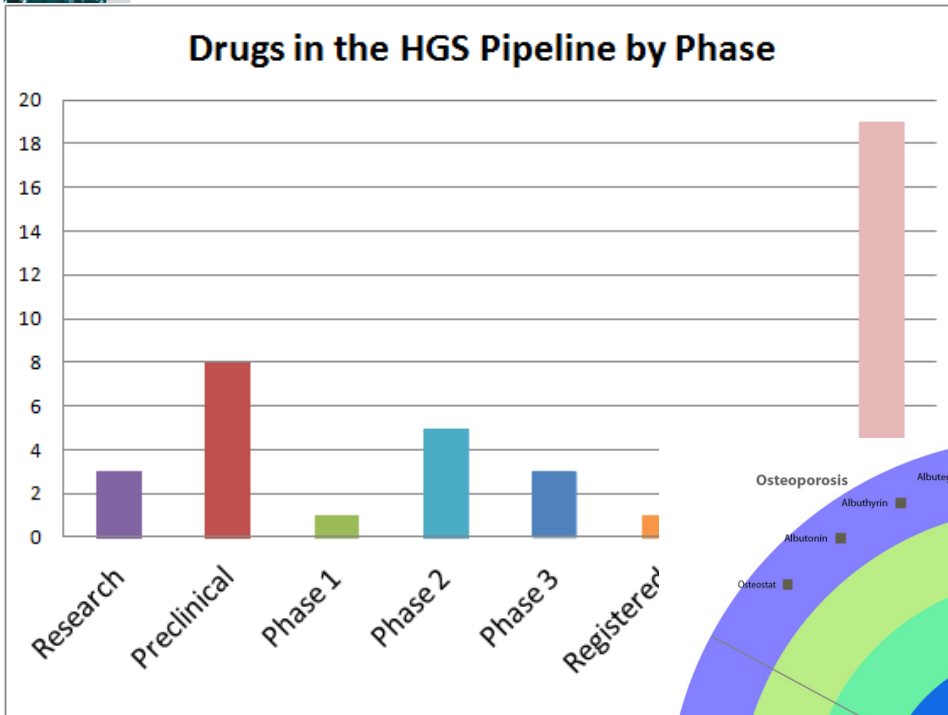
Some issues creating pipeline bulls-eyes...



Some issues creating pipeline bulls-eyes...



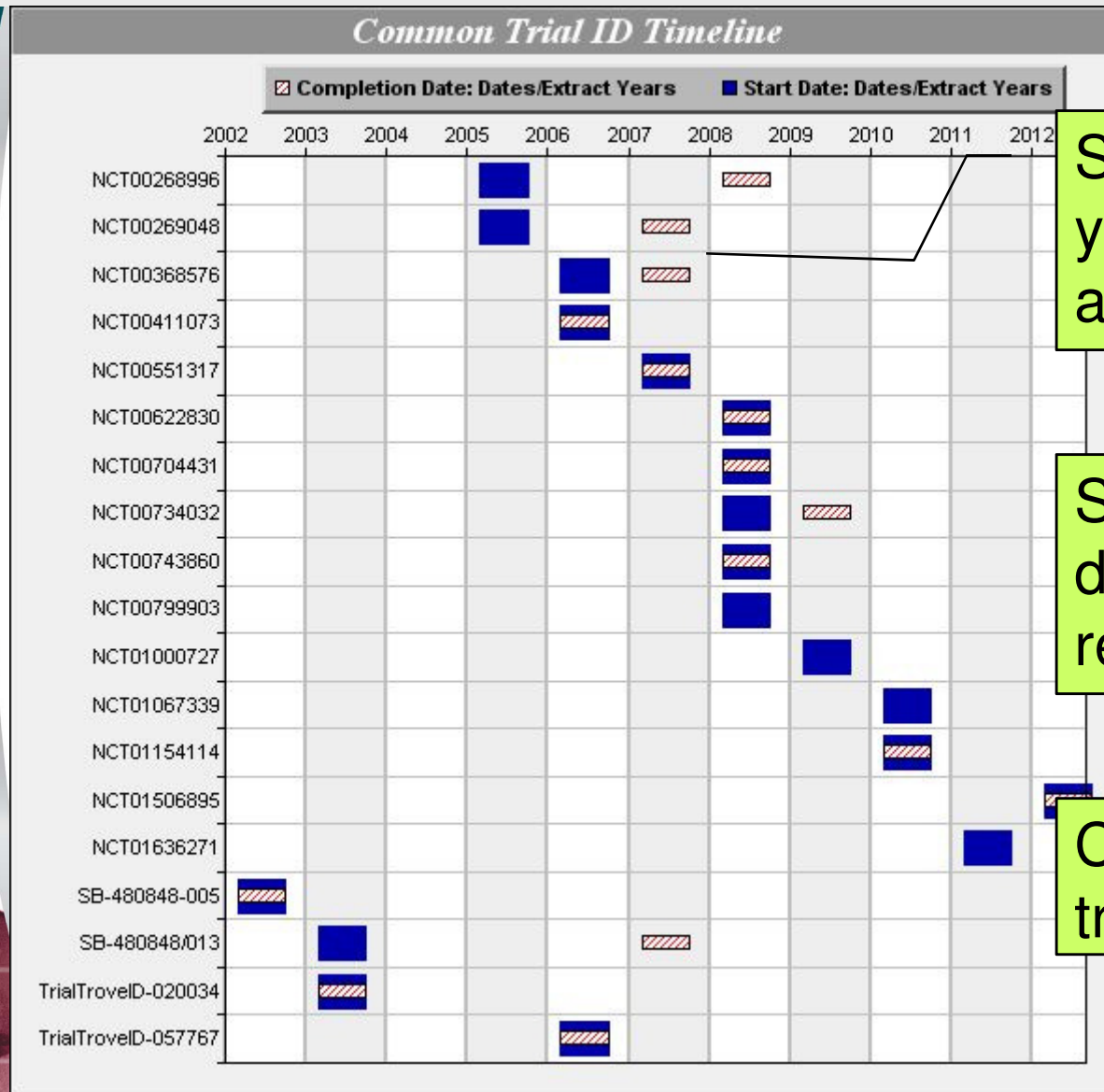
And we want to use our phase color palette



The “phase” in a drug pipeline database...

- Represents the furthest progress of clinical trials for one or more indications in one or more markets.
- There may be multiple clinical trials in progress.
- We want to show a **timeline of clinical trials** for a particular drug.
- Sources: ClinicalTrials.gov; Citeline Trialtrove; Adis Clinical Trials Insight

Applying a standard GANTT visualization



Start/Completion years not shown in a familiar format

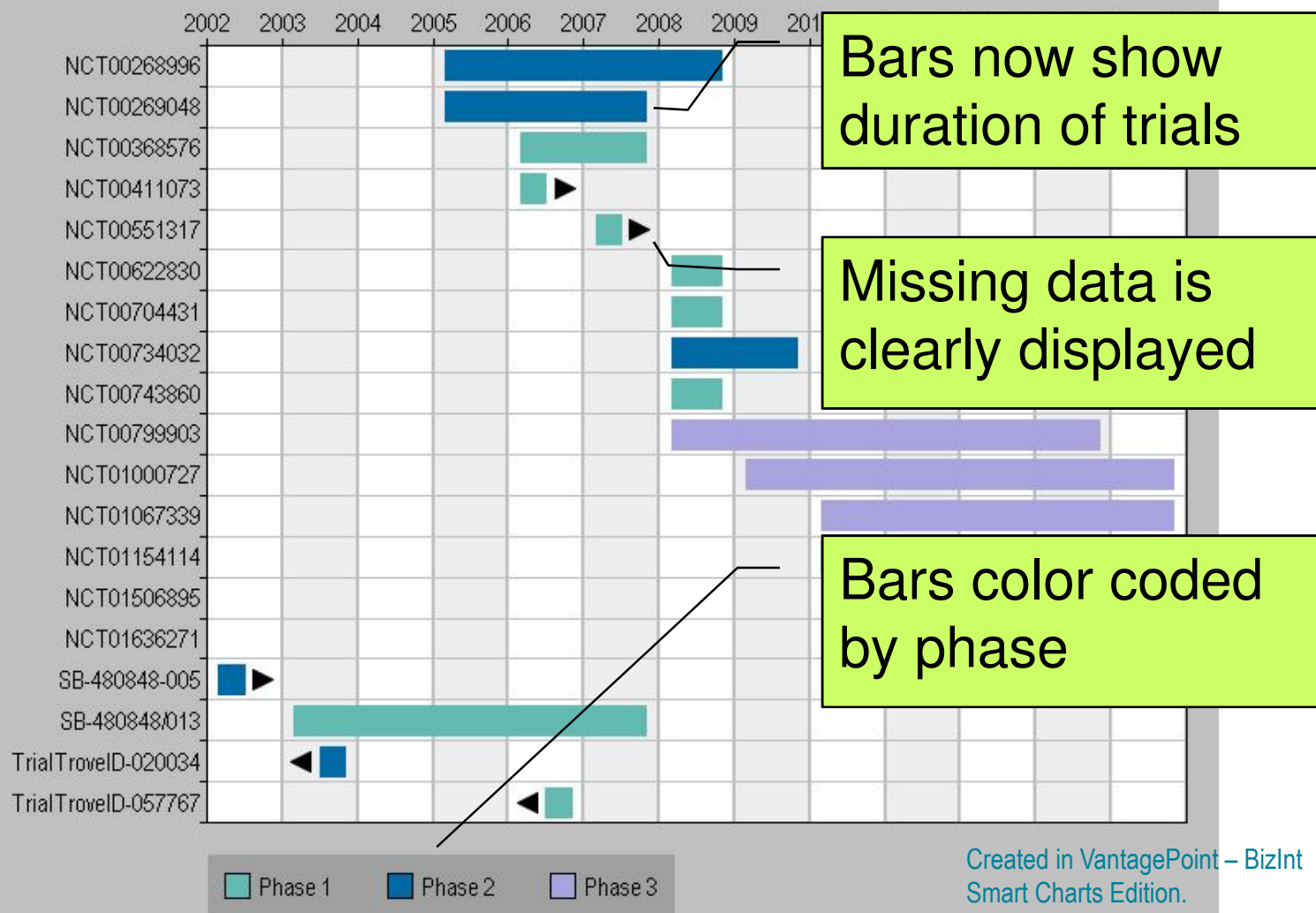
Significant manual data cleanup required

Cannot see the trial phase

Created in VantagePoint – BizInt Smart Charts Edition.

A better trial timeline

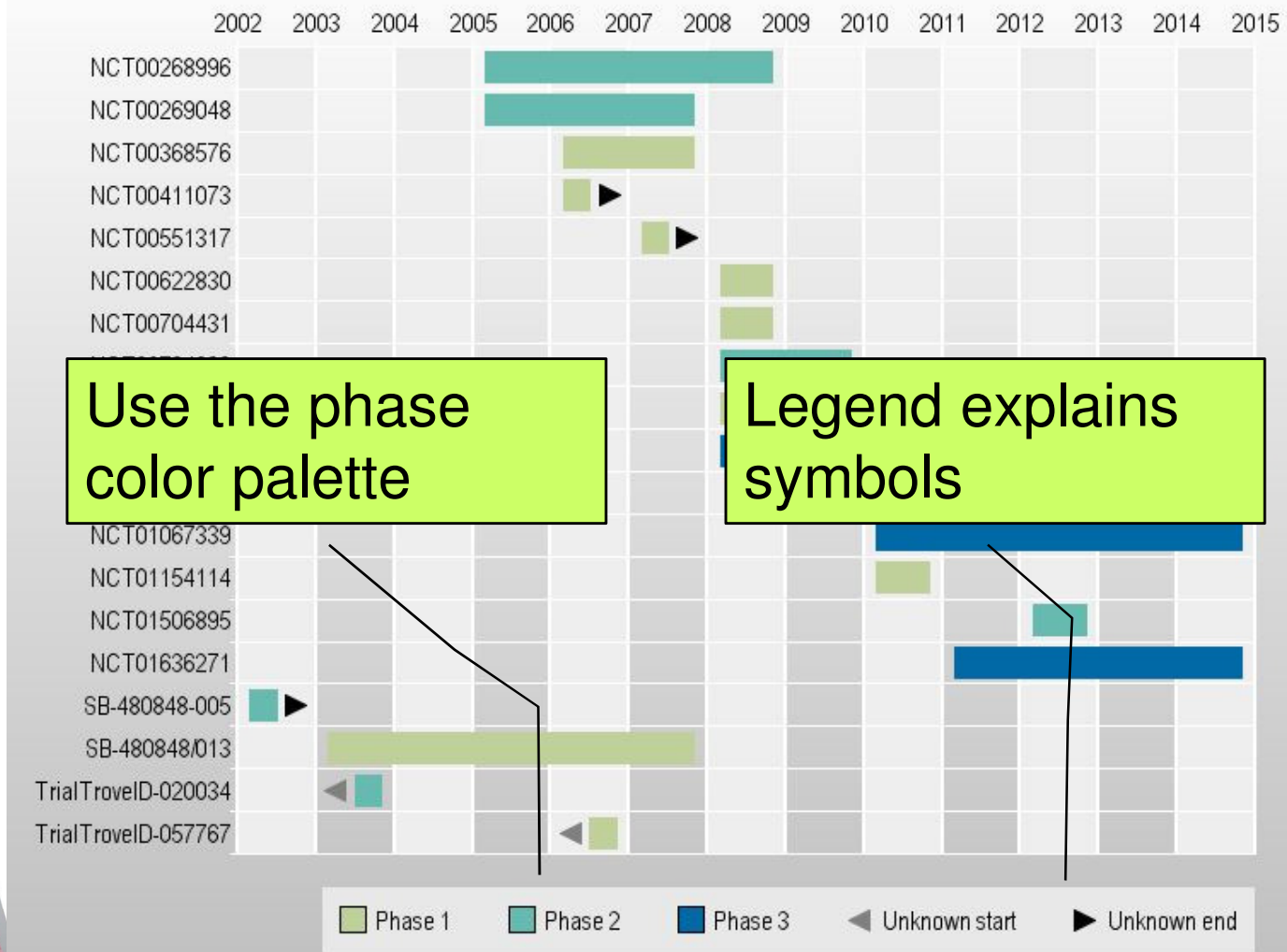
Darapladib Trial Timeline



Created in VantagePoint – BizInt
Smart Charts Edition.

Consistent use of color

Trial Timeline (CT.gov, Adis, TrialTrove)

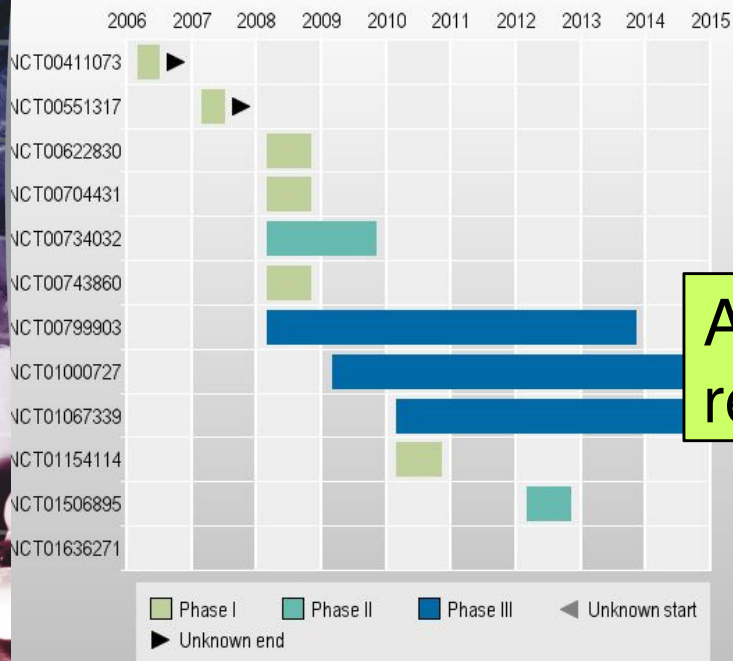


Created in VantagePoint –
BizInt Smart Charts Edition.

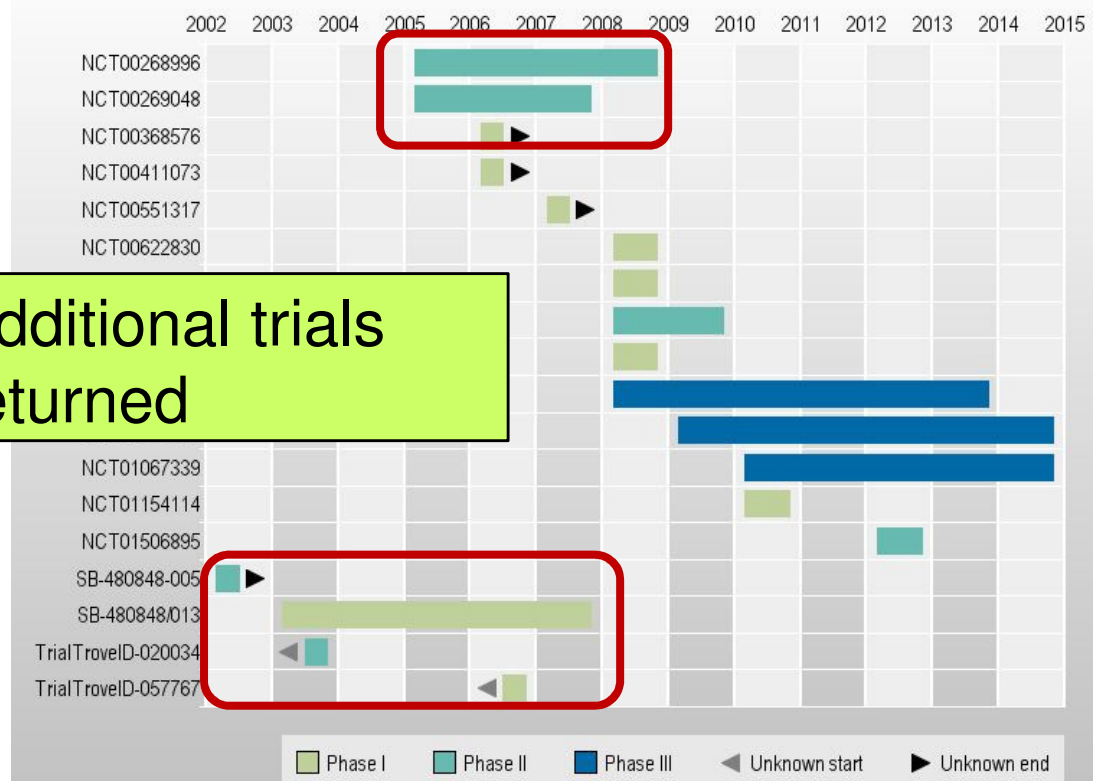
Why use multiple sources?

- Indexing differences may return different results.

ClinicalTrials.gov only



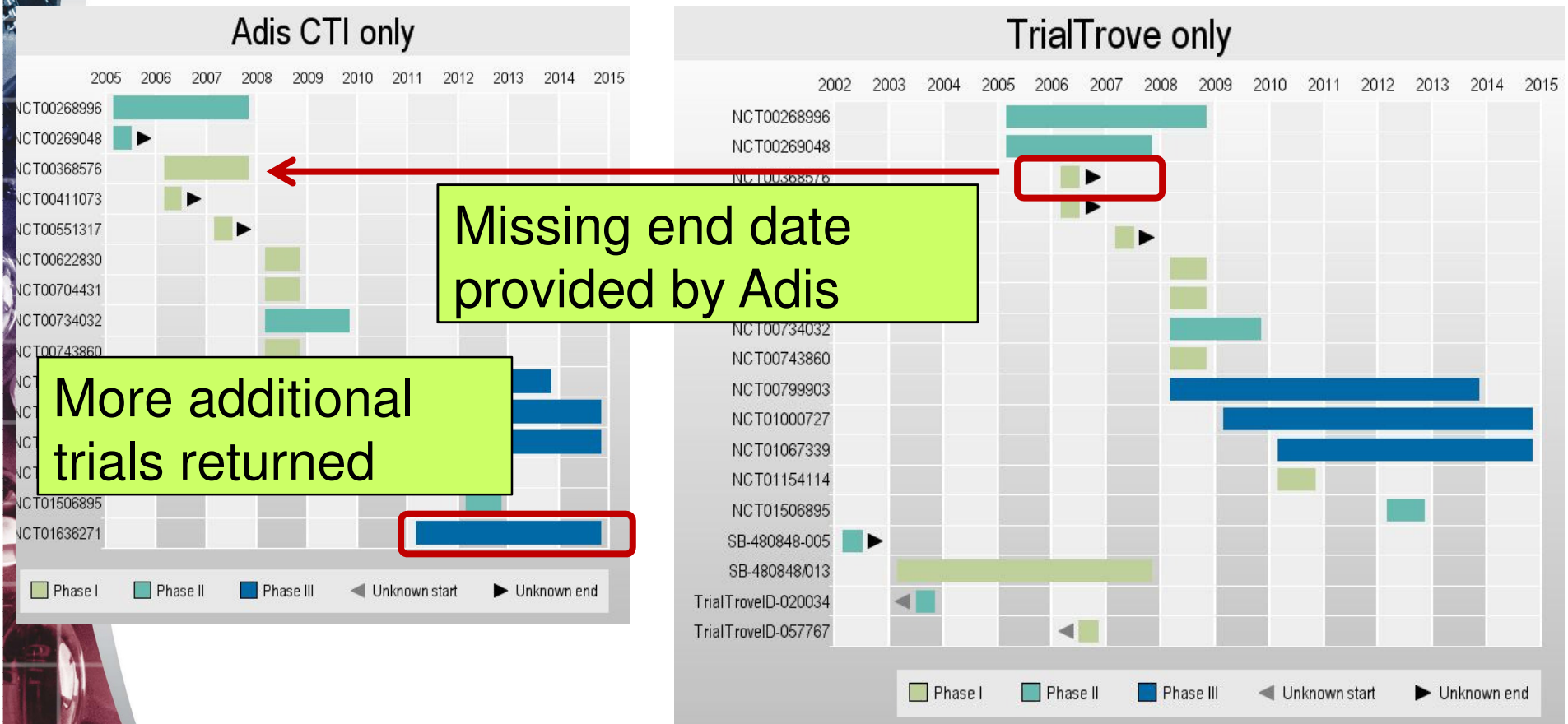
TrialTrove only



Additional trials returned

Why use multiple sources?

- Take advantage of content variation





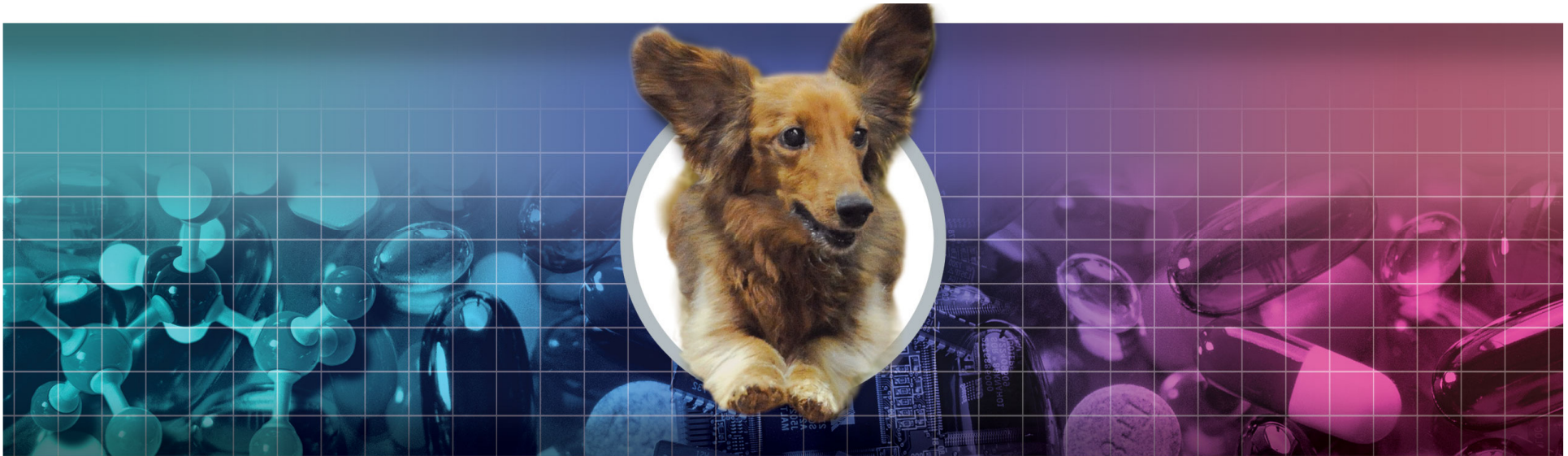
To summarize, pipeline visualizations...

- Require multiple sources for completeness and accuracy.
- Rely on data cleanup and deduplication tools.
- Generally cannot be created with standard visualization libraries.

And pipeline visualizations...

- Often show discrete rather than aggregate values.
- Often show categorical rather than numeric coordinate values.
- Need consistent use of order and color coding.

Do these visualizations operate at the *exploratory* or *explanatory* levels?



Slides at:
bizcharts.com/slides

Thank you!