Drug Repurposing in the Context of Drug Development

Michael Ringel, PhD JD
Partner and Managing Director

June 24, 2013
Productivity decline

1. Decrease in ROI driven by 54% decrease in PTRS, 30% increase in costs, partially offset by 25% increase in operating margin from COGS and SG&A savings
Note: R&D costs are estimated from PhRMA annual survey 2009; NMEs are the total number of small molecule and biologic approvals by the FDA. Based on approved NMEs from 2002-2011 and R&D spend from 1998-2007, discount rate = 11%
Source: Bernstein Research "The Long View – R&D Productivity" (September 30, 2010), and BCG model of R&D economics

~40% decrease in R&D IRR\(^1\)

Long-term range of WACC (8-10%)

1998 15.0%
2010 8.5%
Proximate cause: cost of failure

Attrition rates

Preclinical Phase I Phase II Phase III

100% 100% 100% 100%

50% 50% 50% 50%

0% 0% 0% 0%


Δ15% Δ68% Δ69% Δ165%

Note: All costs capitalized, in 2006 USD
Proximate cause: cost of failure

**Cost per drug ($B)**

- **1990-1994**
  - 20% CAGR
  - Cost of failure
  - Cost of molecule

- **2004-2008**
  - 5% CAGR

Note: All costs capitalized, in 2006 USD

Sources: Pammoli et. al (June 2011) "The productivity crisis in pharmaceutical R&D" Nature Reviews Drug Discovery; Parexel statistical sourcebooks, PharmaProjects, BCG pharmaceutical cost of development model, BCG analysis
The strategy: kill your losers

Source: Dilbert by Scott Adams
Many unfortunate human situations unfold in the top right cell. We take gambles to keep slim hopes alive... likely to lead to even greater losses.
A simple heuristic... part one

Hammer Seeking Nail

May be 'good money after bad'
At the same time, significant reason for optimism

**Genome-wide capabilities**

(ENCyclopedia Of DNA Elements)

Transcriptome Reference Sets (MRT Project)

KO mice genome-wide (KOMP)

>1,200 GWAS; 400 hits on the cusp

**Deeper understanding of pathways...**

Cancer pathways

**...and targets**

NSCLC targets

Sources: Christopher Austin, NHGRI; Francis Collins (2011) Target Validation: Joint NIH-Industry Workshop; Hanahan & Weinberg (2000); National Research Council of the National Academies (2011) Toward Precision Medicine
Tools coming together

NPC
NCATS Pharmaceutical Collection

Drug Discovery Assays

PD²
Phenotypic Drug Discovery

Target D²
Target Drug Discovery

Targets

Libraries
Reasons why biopharma would fail to invest

1. Near patent expiry
2. Past patent expiry
3. Not your molecule
4. Not patentable
A simple heuristic... part two

Nail Seeking Hammer

May be valuable (to patients)
Some example companies

- **Platform tools**
- **Knowledge-based approach**
- **Outlicensing**
- **Fully-integrated pharmaco**

**Some example companies**

- **Revenue: $20M**
  - Melior Discovery
  - Numedicus

- **Revenue: $2,000M**
  - Sosei
  - Pfizer

- **Revenue: $4,000M**
  - VIAGRA (sildenafil citrate)
  - Celgene

**Crowd-sourcing platforms**
(eg, Innocentive)

Source: Company websites, Orbis
Some example government and consortium efforts

Medicines Chest

Biomedical Catalyst: Developmental Pathway Funding Scheme

Rare Disease Repurposing Database
A simple heuristic

Hammer Seeking Nail

Nail Seeking Hammer

More likely to be 'good money after bad'

More likely to be valuable

But of course... it depends on the specific situation