

***Reaping the Fruits of the
Clinical Research Tree
using AI & ML***

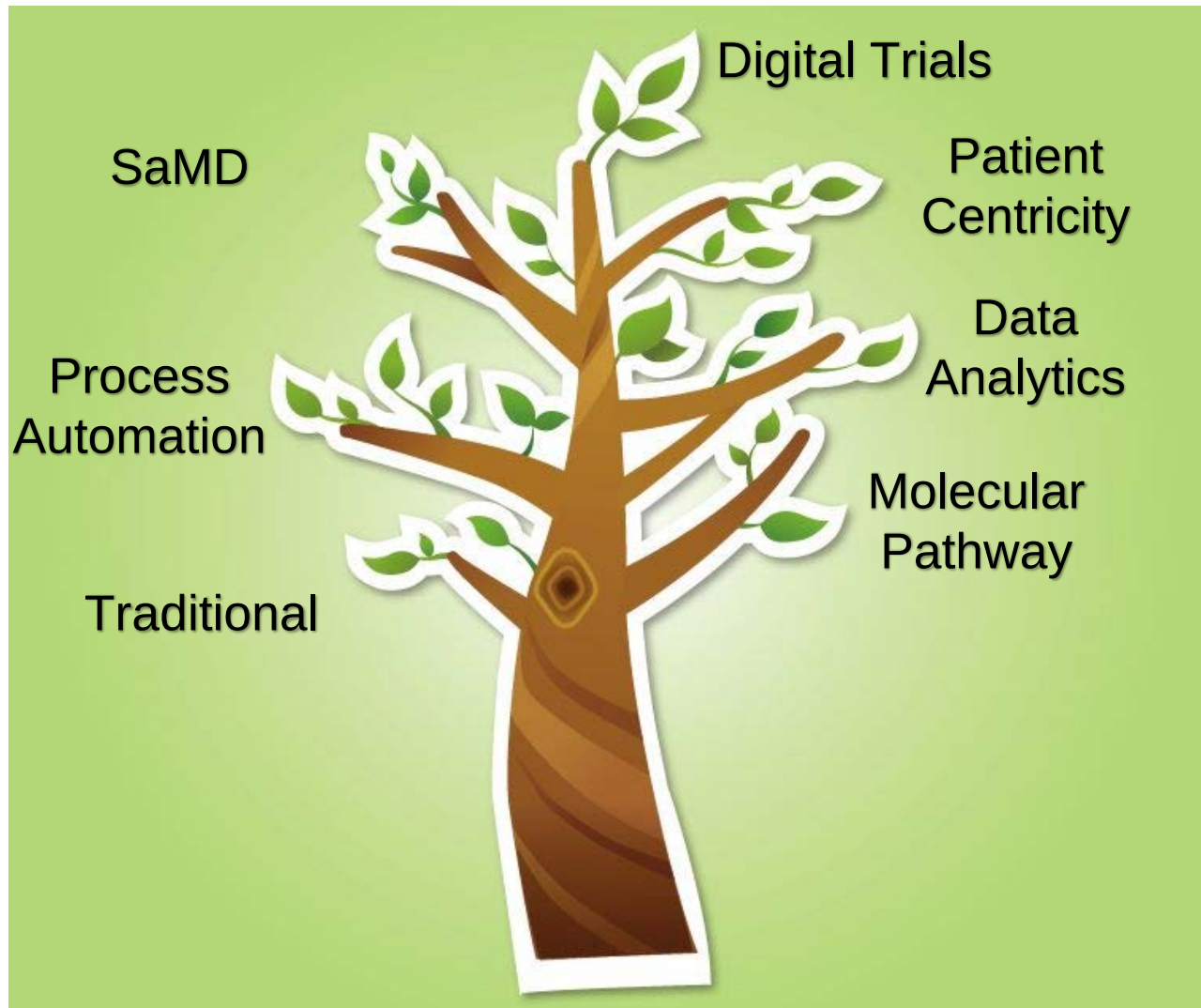
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- Sineflex Solutions has deep expertise in the healthcare domain and bring extensive experience in designing and delivering innovation related offerings
- Dinesh Pillaipakkamnatt has over 26 years of experience in various domains including healthcare, insurance, pension, imaging and training. Roles include Entrepreneur, Innovation Council Lead, Digital Development Lead and Head, Data Analytics and Learning Solutions.
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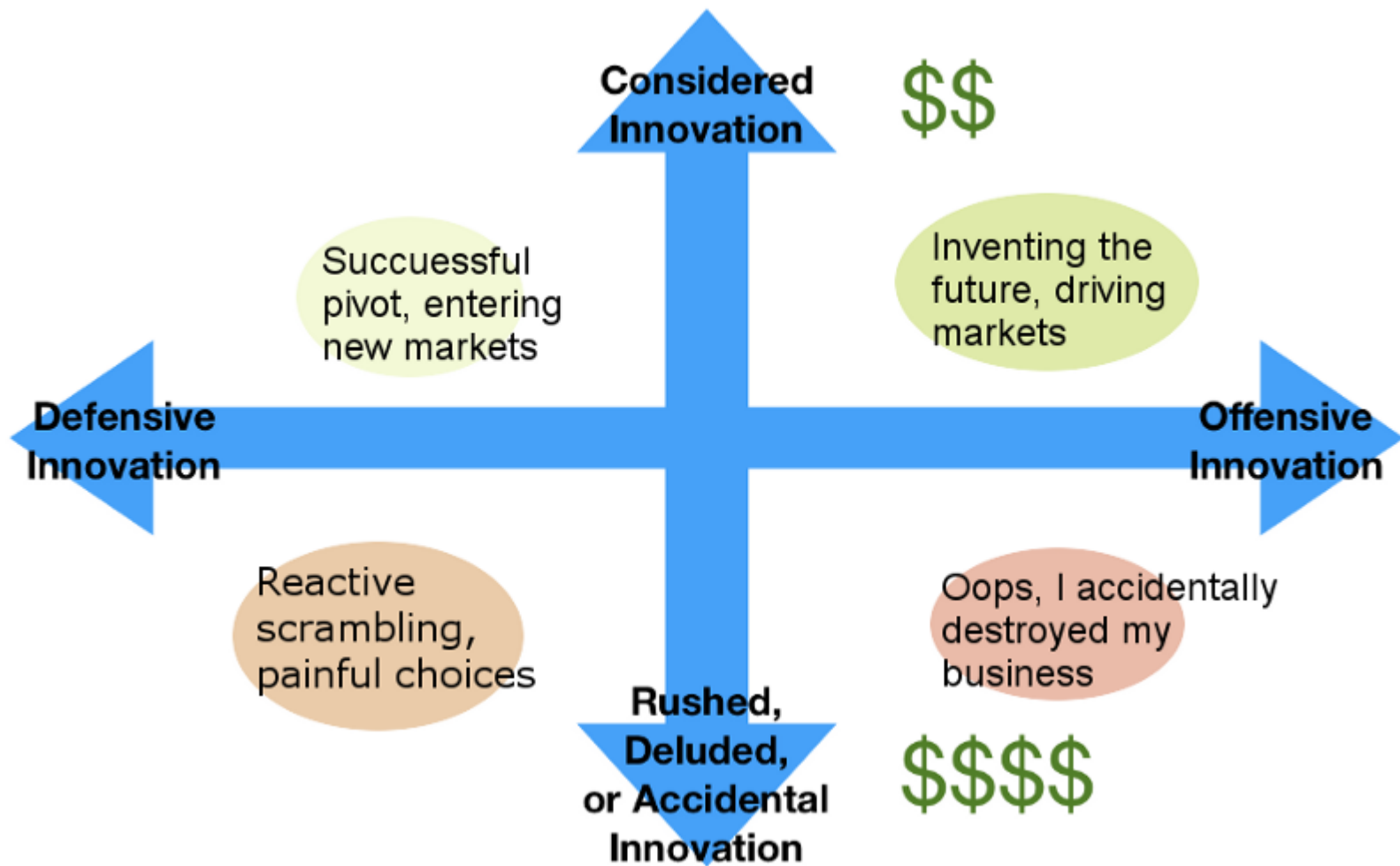
Setting the context – Clinical Research Tree : Version 1 - Overview



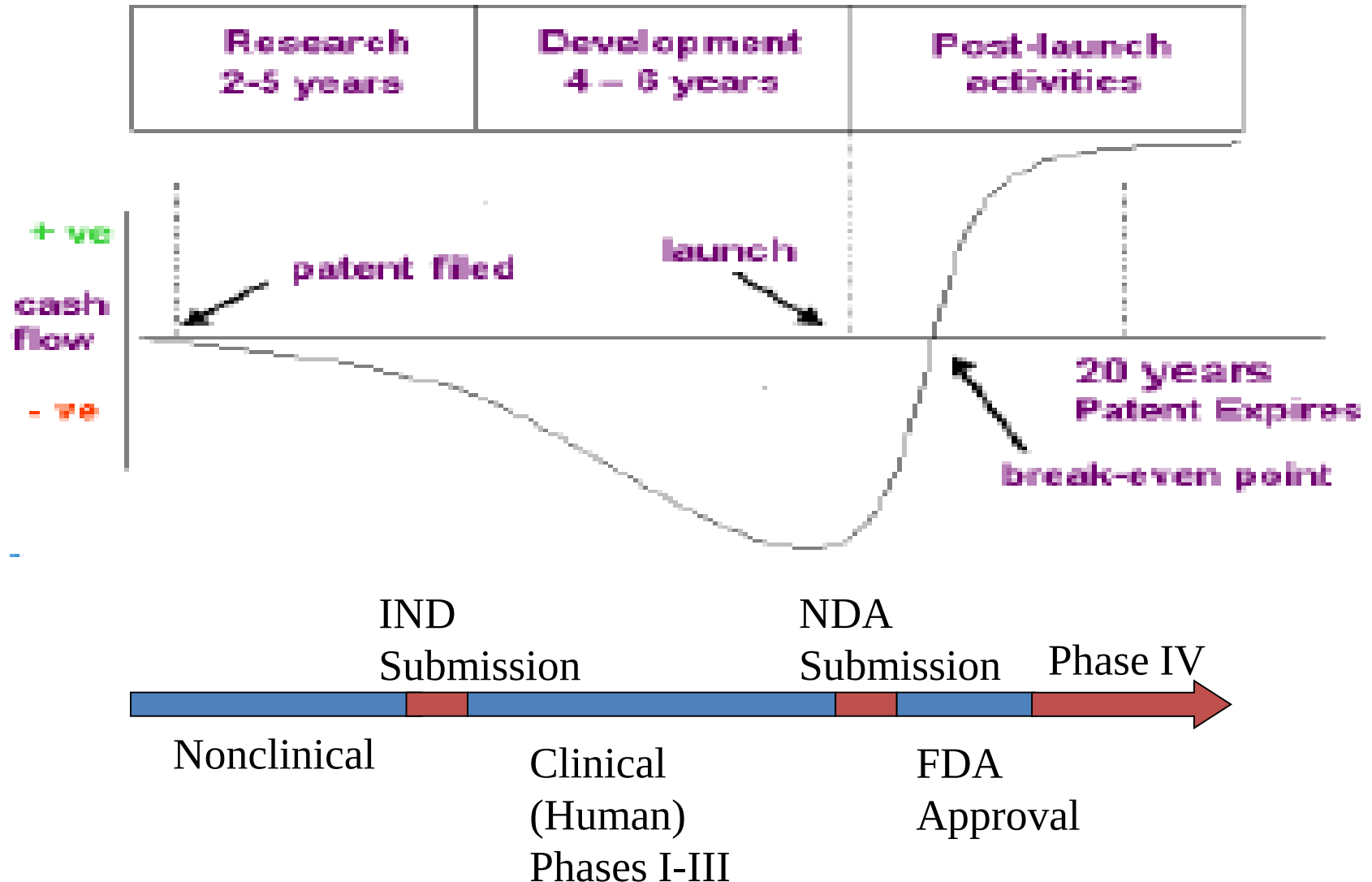
Setting the context – Clinical Research Tree : Version 1 - Traditional



Where is the pharma business in the Innovation Quadrant? New molecules vs Generics?



Is the current Pharmaceutical Development process a sustainable business model?

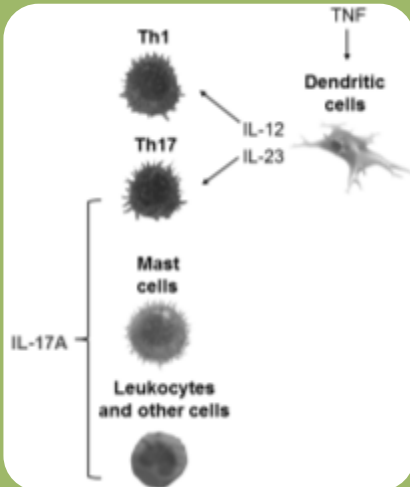


Setting the context – Clinical Research Tree : Version 2 - Molecular Pathway

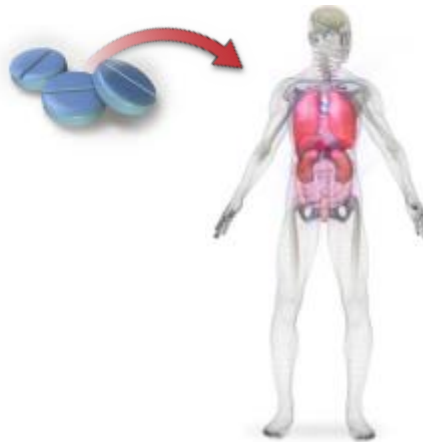


Developing drugs and changing medical practice

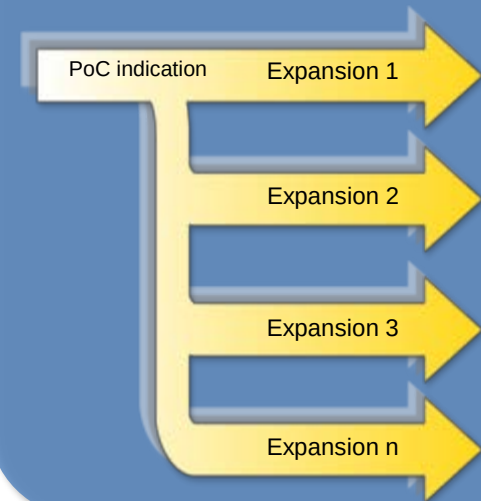
Understanding molecular biology



Proof-of-concept (PoC) clinical trials



Parallel indication expansion studies



Traditional model

Indication 1



Launch timeline

Indication 1

Indication 2

Indication 3

Indication 4

Indication 5

potential patient impact



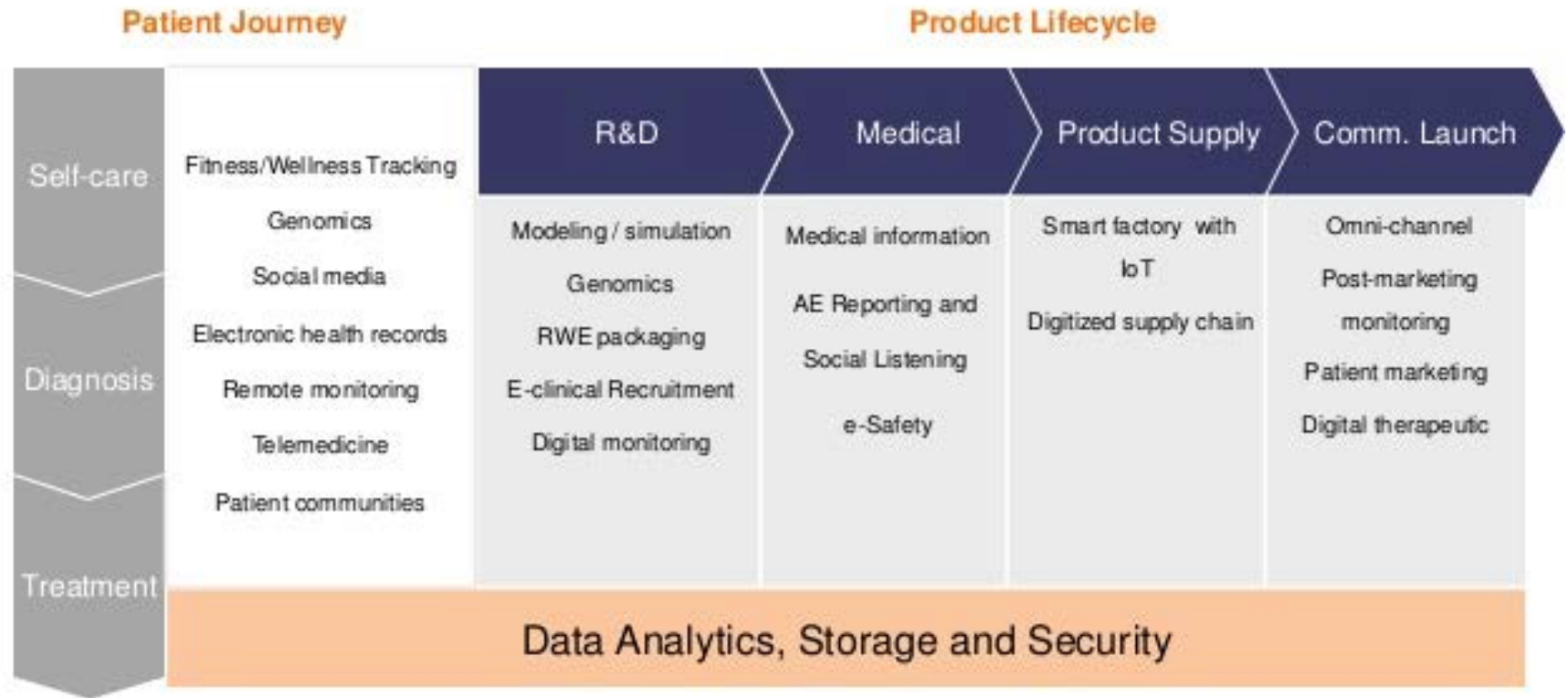
New model

Setting the context – Clinical Research Tree : Version 3 – Data Analytics



Pharma Analytics Value Chain :

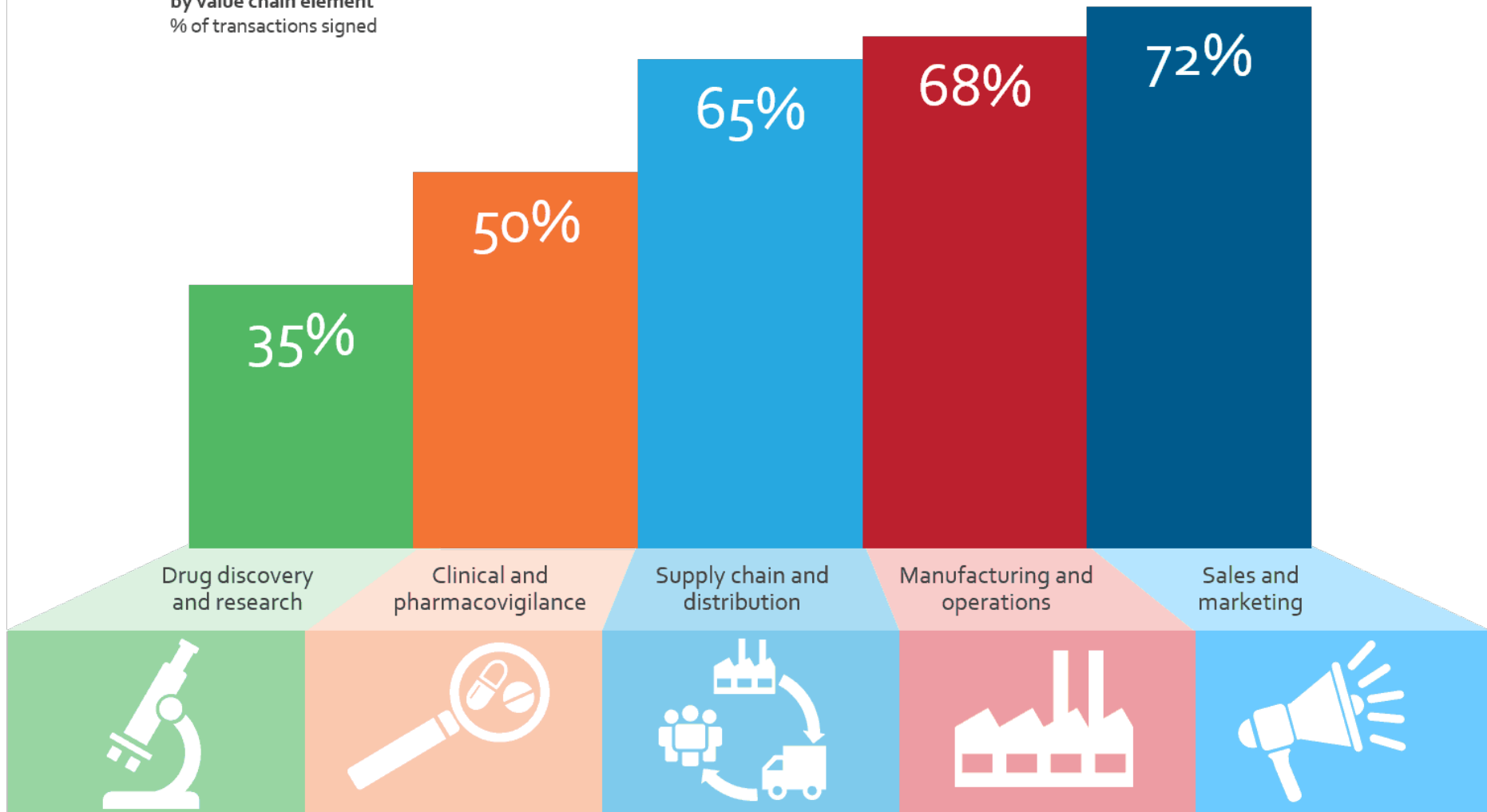
The rise of Data and Digital in a Patient Centric world



Pharma spending on analytics: Where is your money really going?

Though most tout clinical and R&D analytics spending, transaction data shows much higher spend on sales and marketing

Distribution of life sciences big data and analytics IT contracts
by value chain element
% of transactions signed



Setting the context – Clinical Research Tree : Version 4 – Patient Centricity



How to approach an analytics problem – Engineering vs Design?

First, we should know what we are calling a ***problem***:
a perceived **gap** between what we **have** and what we **want**, a situation we want to **change**

<i>Engineering approach</i>	<i>Design approach</i>
• Define problem • Look for best solution • Assumes problem can be well-define • Divide-and-conquer • Based on analytical and mathematical skills • Solution is true or false	• Wicked problems • Try to understand the situation • Explore possibilities to better understand the problem • Iterative work • Sketching • Solution is good or bad, better or worse
Best for: • Technical contradictions • Replication of solutions across similar problems • Automation	Best for: • Incomplete or poorly defined problems • Product creation and changing requirements • User interface and feedback

Source: <https://uxdesign.cc/the-problem-of-identifying-design-with-problem-solving-e5fb88d7d640>

Design Thinking is a problem solving framework. The concept has been around for decades, but in the past five to ten years, product companies have championed the process as an alternative to a purely analytical approach to problem-solving.

Pharmaceutical Organizations and Design Thinking have very similar goals:

The goal of **improving lives** is an important endpoint to the process of drug development and design thinking. In fact, it's what design thinking is all about: finding fresh, creative solutions to problems, but in a way that puts **people and their needs first**.

Instead of starting with a problem, design thinking starts with observation. It's informed by an understanding of the culture and the context of a problem (what people need), rather than the problem.

- 1) **Empathize: Understand Your Audience**
- 2) **Define: Establish a Point of View**
- 3) **Ideate: Focus on Possible Solutions**
- 4) **Prototype: Try Out Multiple Solutions**
- 5) **Test: Find the Best Solution for Your Audience**

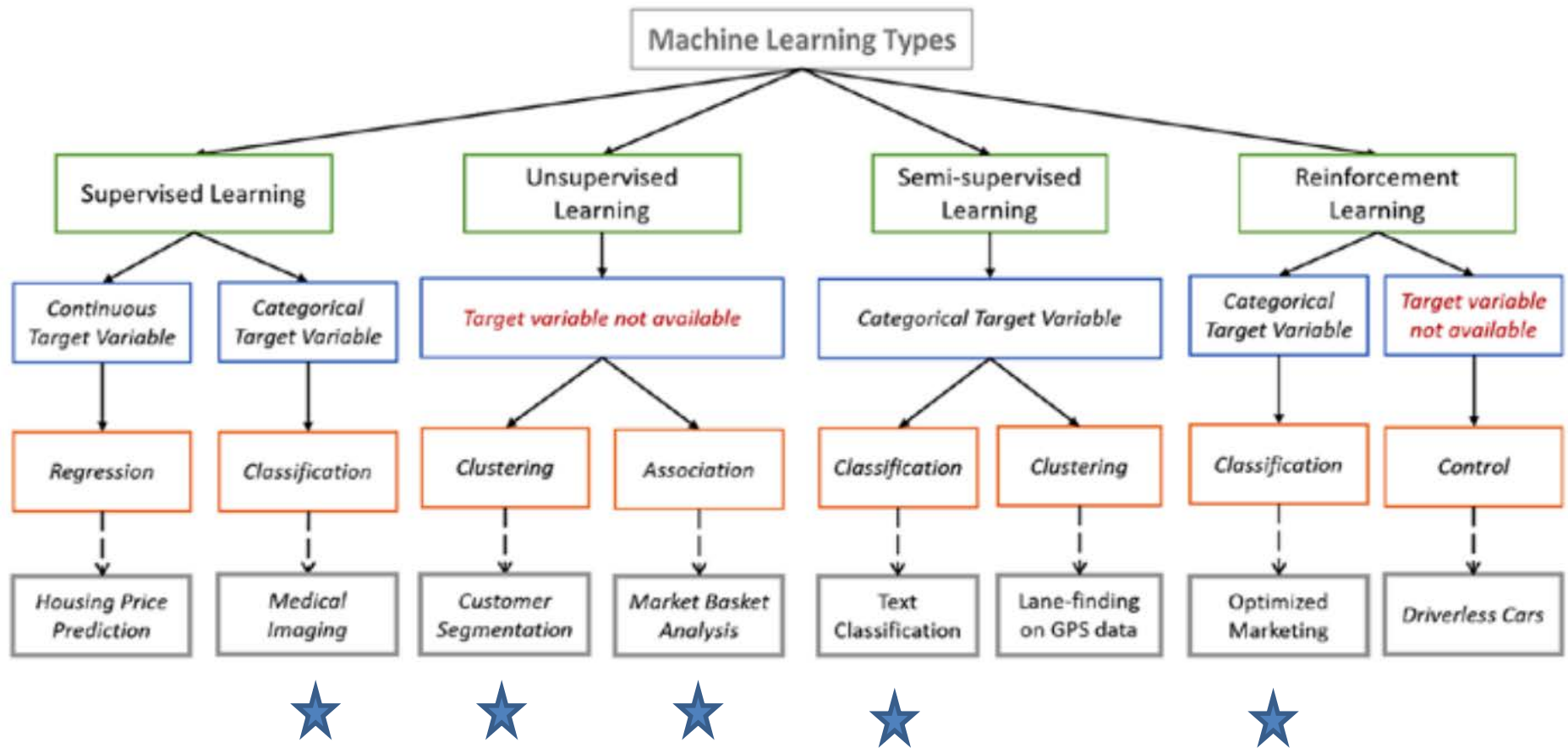
Tim Brown, IDEO's president and CEO, defines design thinking like this:

"The mission of design thinking is to translate observation into insights and insights into products and services that will improve lives."

Setting the context – Clinical Research Tree : Version 6 – Algorithms

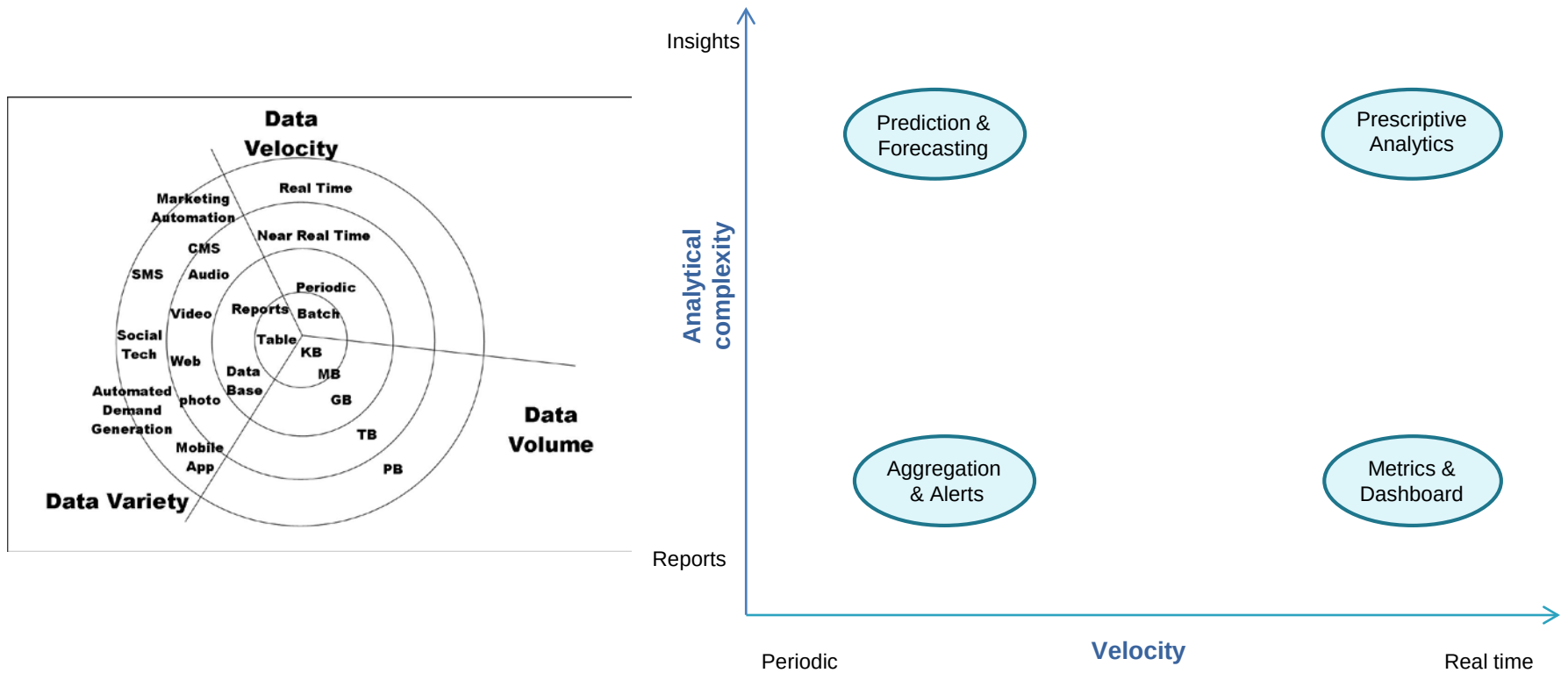


Making Decisions through Algorithms



Picking the right problem to solve – What is the type of analysis done in each quadrant?

For example, on what type of data will *Forecasting* be used?



Setting the context – Clinical Research Tree : Version 6 – Software As a Medical Device (SaMD)



Why AI/ ML algorithms are taking center stage?

FDA pre-certification program: SaMD

Table 3. Level of Review for Level 1 and Level 2 Precertified Organizations' SaMD

IMDRF Risk Categorization			Level of Review for Level 1 and Level 2 Precertified Organizations' SaMD		
Type	Sub type	Description	Initial product	Major changes	Minor changes
Type IV	(9)	Critical x diagnose/treat	SR	SR	No Review
Type III	(8)	Critical x drive	SR	L1 – SR L2 – No Review	No Review
Type III	(7)	Serious x diagnose/treat	SR	L1 – SR L2 – No Review	No Review
Type II	(6)	Serious x drive	L1 – SR L2 – No Review	L1 – SR L2 – No Review	No Review
Type II	(5)	Non-serious x diagnose/treat	L1 – SR L2 – No Review	No Review	No Review
Type II	(4)	Critical x inform	L1 – SR L2 – No Review	No Review	No Review
Type I	(3)	Non-serious x drive	No Review	No Review	No Review
Type I	(2)	Serious x inform	No Review	No Review	No Review
Type I	(1)	Non-serious x inform	No Review	No Review	No Review

Regulatory changes

1. FDA published its [17-page first draft of a working model](#) for its pre-certification program for software as a medical device (SaMD).
2. The risk framework used will be the same framework in the IMDRF guidelines [the FDA adopted in December](#).
3. [The clinical decision support guidance](#) is the most noteworthy — and the most controversial. The new guidance lays out forms of clinical decision support that won't be regulated, but does so based on the degree of human involvement, rather than based on risk. Essentially, the document says CDS won't be regulated if the physician can independently review and understand the basis of the software's decision

AI in Medicine: Diagnostics, Development



Detecting **lung cancer**
from CT Scans

classification



Assess **cardiac health**
from electrocardiograms

prediction



Classify **skin lesions**
from images of the skin

classification



Identify **retinopathy**
from eye images

clustering

The 4 Stages in Drug Development



Identify **target**
molecules

regression



Discover
effective drugs

correlation



Speed up
clinical trials

prediction



Find **biomarkers** for
diagnostics

classification

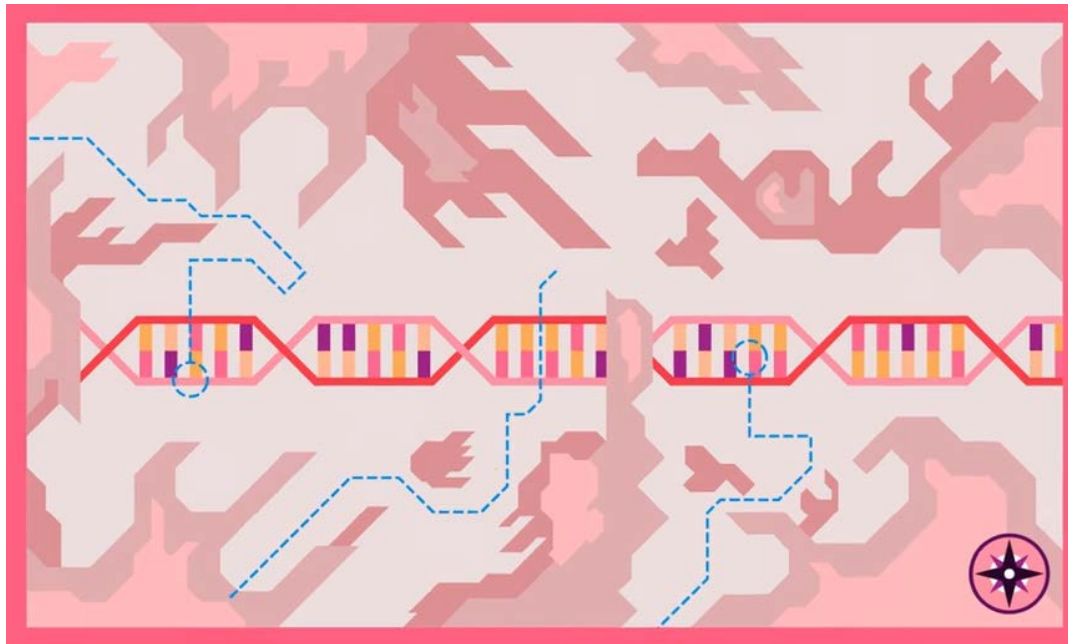
AI in Medicine: Personalization, Gene Editing

Treatment Personalization

- Response to particular treatment (Similar patient using K-Nearest Neighbor)
- CAR-T for cancer immunotherapy (targeted modification of T-cell and replication using ML)

Gene Editing

- CRISPR and CAS-9 with Learning Systems built in for selecting right guide RNA
- Predicting guide-target and off-target effects for a given sgRNA



FDA roundup: The major device, app, and algorithm approvals of 2018



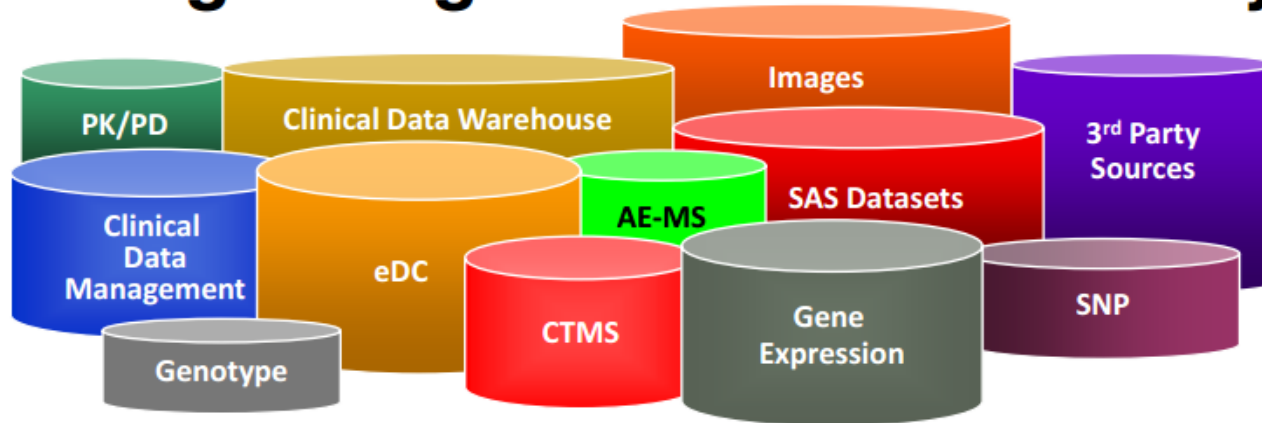
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- SINEFLEX**
SOLUTIONS

Setting the context – Clinical Research Tree : Version 7 – Data Integration and Cloud



In a Clinical Data Warehouse, having the right data available is key

Having the right data available is key



Need, Availability and Challenges:

- Most companies hold large volumes of data that fuel your development projects, however different databases cover different domains of information and knowledge
- Diverse, inconsistent workflows and decision support processes
- Access to all information is critical if you are to be able to identify safety "signals" and manage patient risk
- No easy way to classify and consolidate data with contextual information

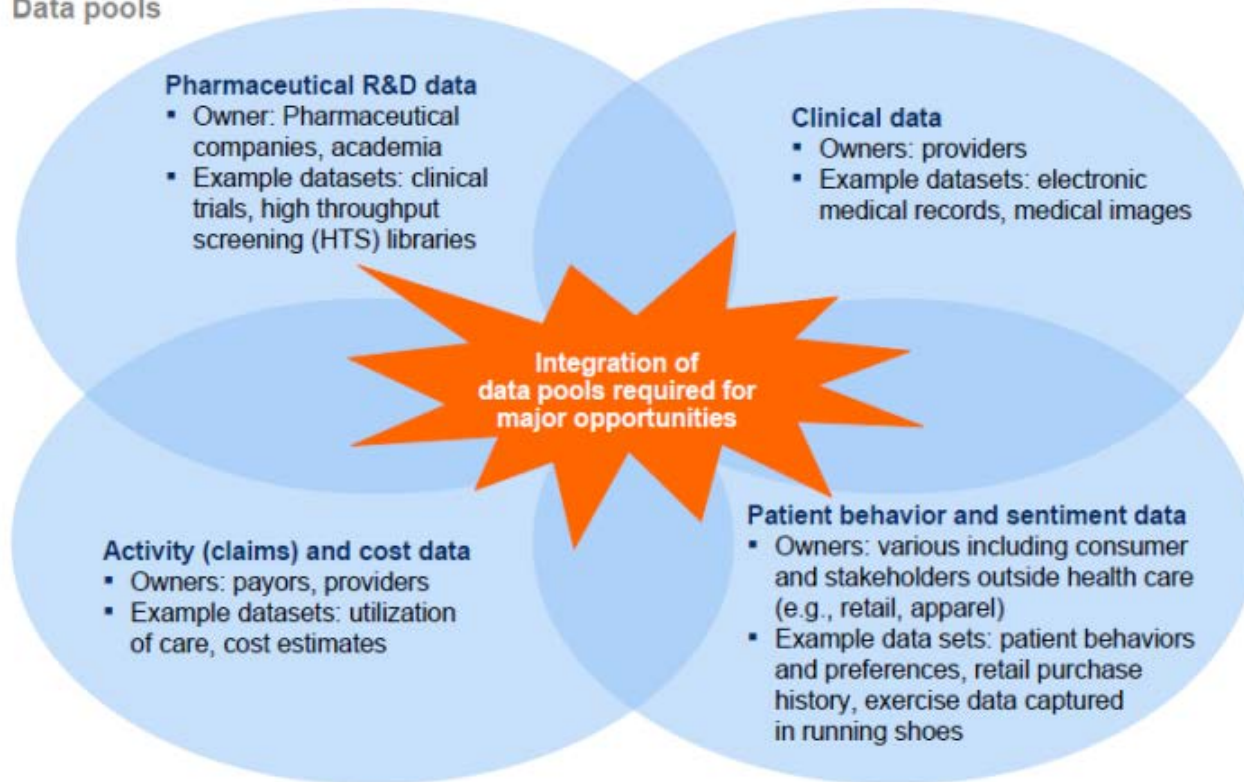
Where are the unstructured health data sources? Are there any data standards that govern such data?



At the moment, data from clinical research (pharma), clinical practice (doctors), clinical services (hospitals, payors) and patient behaviour (social media) are distinct

Four distinct big data pools exist in the US health care domain today with little overlap in ownership and low integration

Data pools



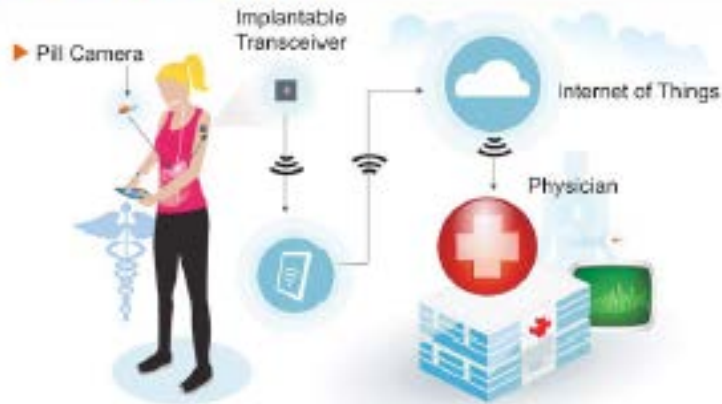
SOURCE: McKinsey Global Institute analysis

Setting the context – Clinical Research Tree : Version 5 – Digital Trials

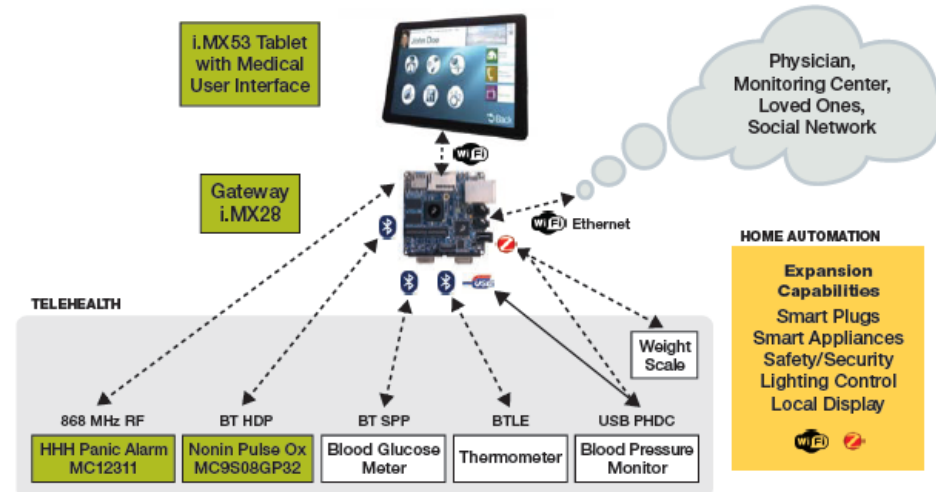
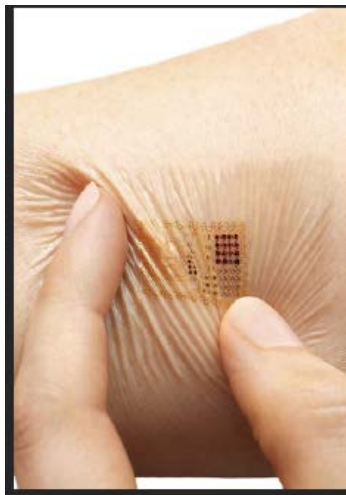


What next : Digital Trials

Remote Patient Monitoring



Home Health Hub Reference Platform



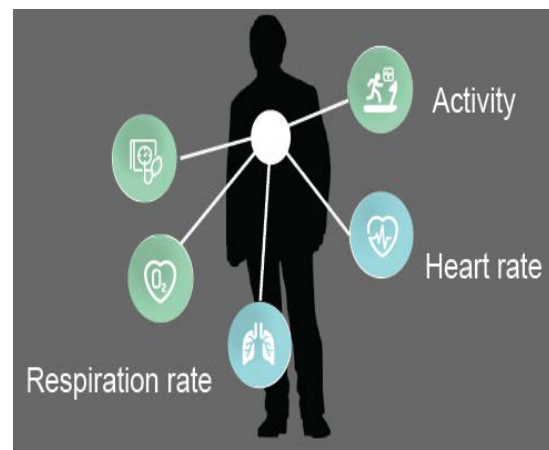
WHERE : Opportunities for Implementation

Data Structure

Risk Analytics

Country	Enrollment completed	2012					2013						
		Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
USA	93	40 /85	44 /98	48 /98	53 /98	56 /98	59 /98	62 /98	72 /98	77 /96	83 /74	88 /75	93 /79
DEU	90	51 /47	54 /52	56 /54	66 /55	68 /55	68 /69	71 /80	74 /80	80 /80	83 /83	89 /85	90 /86
MEX	47	27 /25	28 /28	28 /29	28 /30	30 /32	33 /34	35 /35	36 /36	39 /37	46 /39	46 /46	47 /47
COL	31	16 /15	16 /16	18 /17	19 /18	19 /21	22 /25	25 /27	26 /30	27 /33	30 /29	31 /32	31 /34
CZE	30	27 /28	27 /27	27 /28	27 /28	28 /28	28 /28	28 /28	29 /28	29 /28	30 /30	30 /30	30 /31
BRA	28	3 /8	3 /3	6 /3	9 /5	11 /9	15 /10	19 /11	23 /12	25 /13	26 /25	28 /27	28 /27

Personalized Analytics



Lab Analytics



Social Media Analytics

Identify
Unmet
User
Needs



User
Behavior
Geographic
Trends



Identify
Unintended
Effects

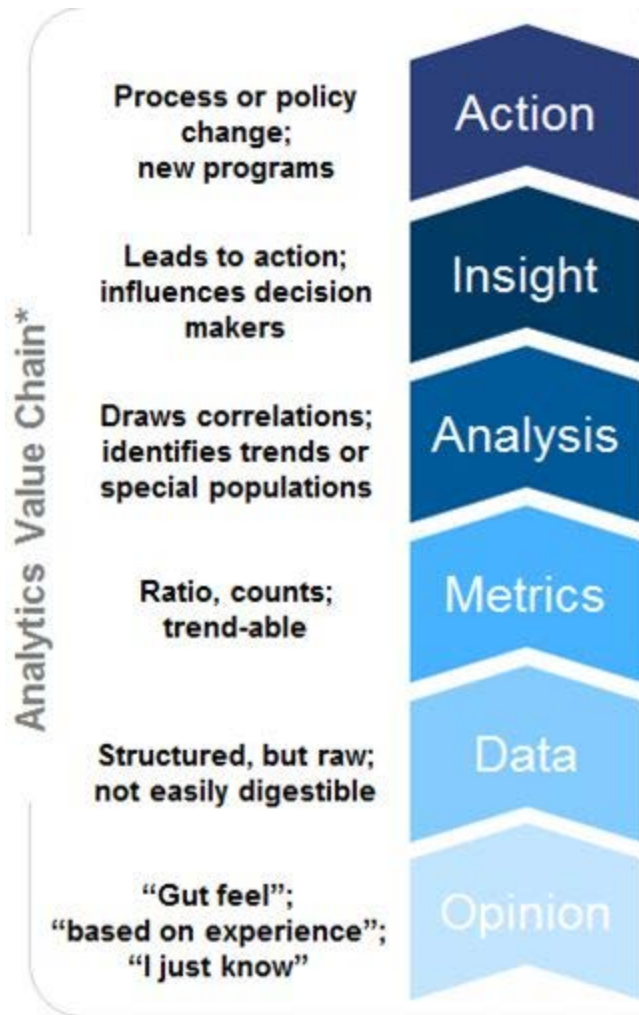


Engage
Groups for
Brands



Data Velocity

Data Analytics Value Chain with Pharma Examples



Insulin Prescription and Lifestyle Recommendation
Target / Lead Identification and Budget Allocation
Market Basket Analysis for Cardiovascular Portfolio
Dashboard for Trial Management with Trial Risks Highlighted
Wearable Data Capture, Compliant with Submission Data to FDA
Data Adjudication Committee for Interim Analysis

Real World Application - The connected patient

