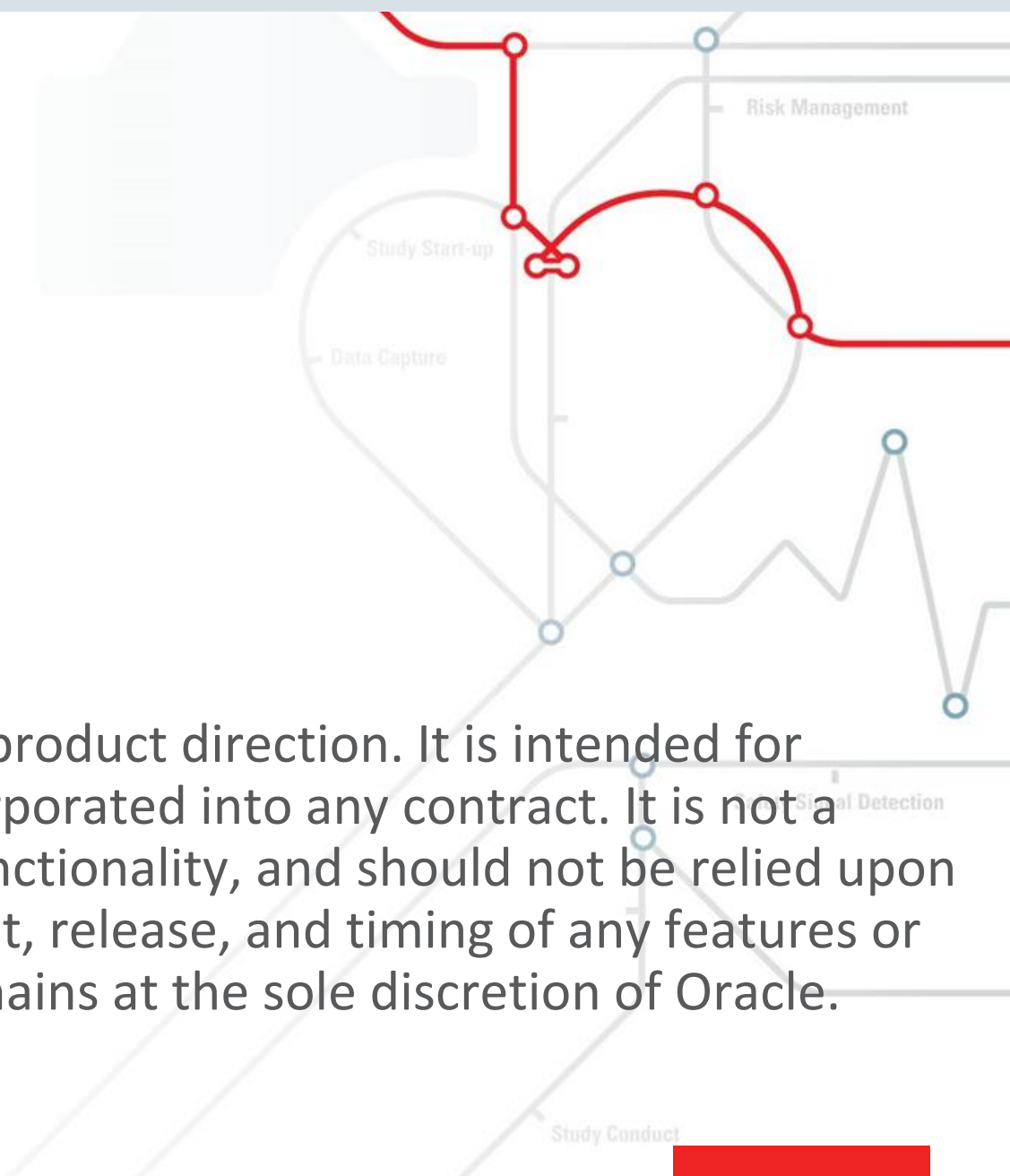


Digital Innovations in Healthcare: Achieving Organizational Transformations with Technology Optimization

Dr. Sameer Thapar
Global Pharmacovigilance Director

PhUSE SDE

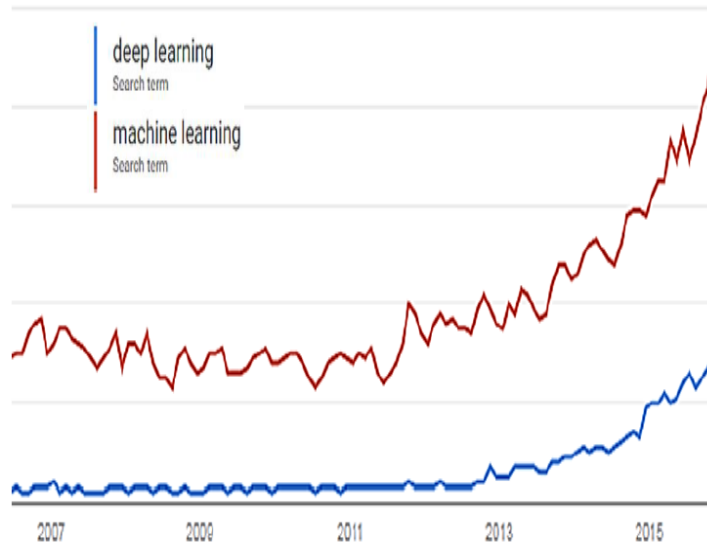
Durham, NC | 9Nov2017



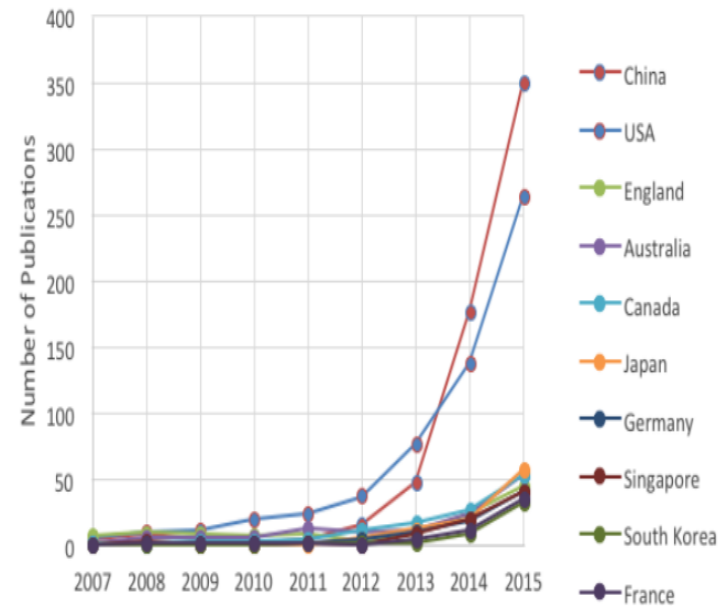
Safe Harbor Statement

The following is intended to outline our general product direction. It is intended for information purposes only, and may not be incorporated into any contract. It is not a commitment to deliver any material, code, or functionality, and should not be relied upon in making purchasing decisions. The development, release, and timing of any features or functionality described for Oracle's products remains at the sole discretion of Oracle.

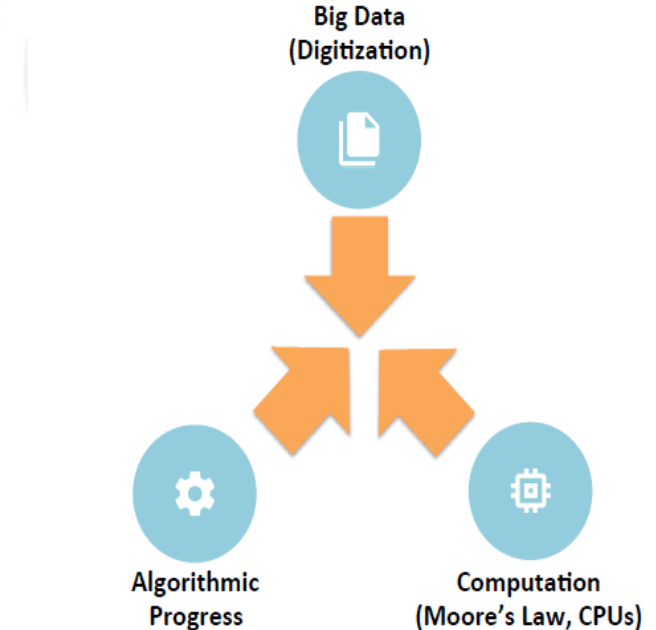
Artificial Intelligence Time Is Optimal



- “Artificial Intelligence” searches is on the rise.
- More in ML than DL

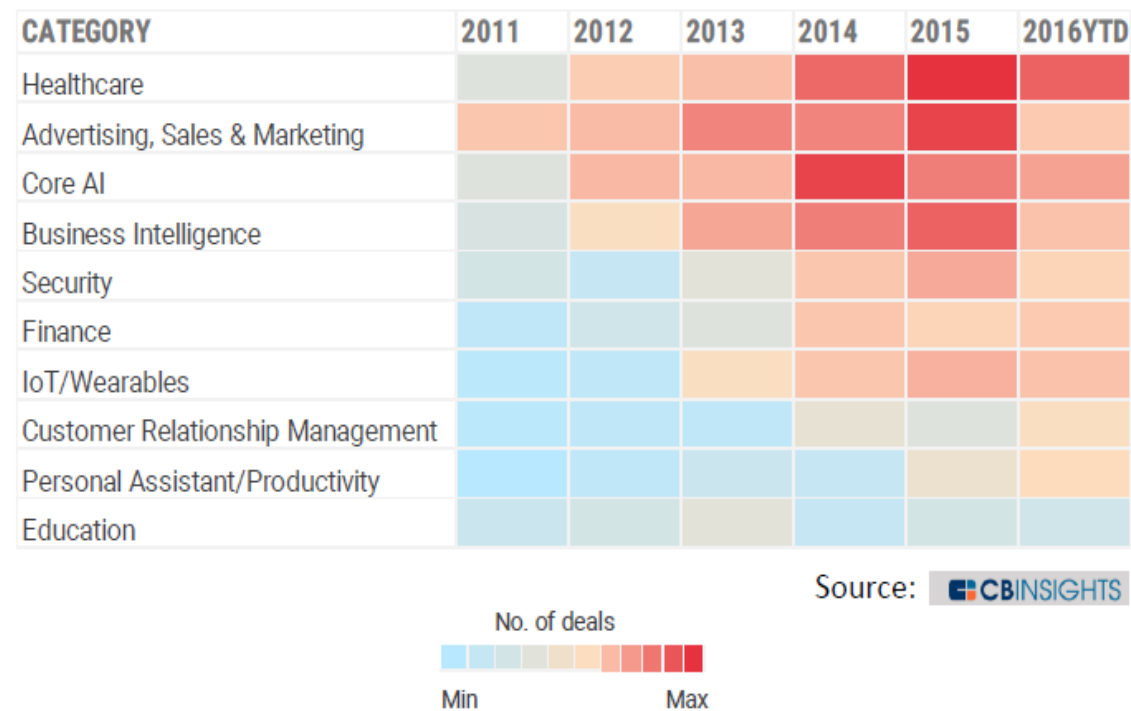


- Academic Publications are increasing
- China, USA leading

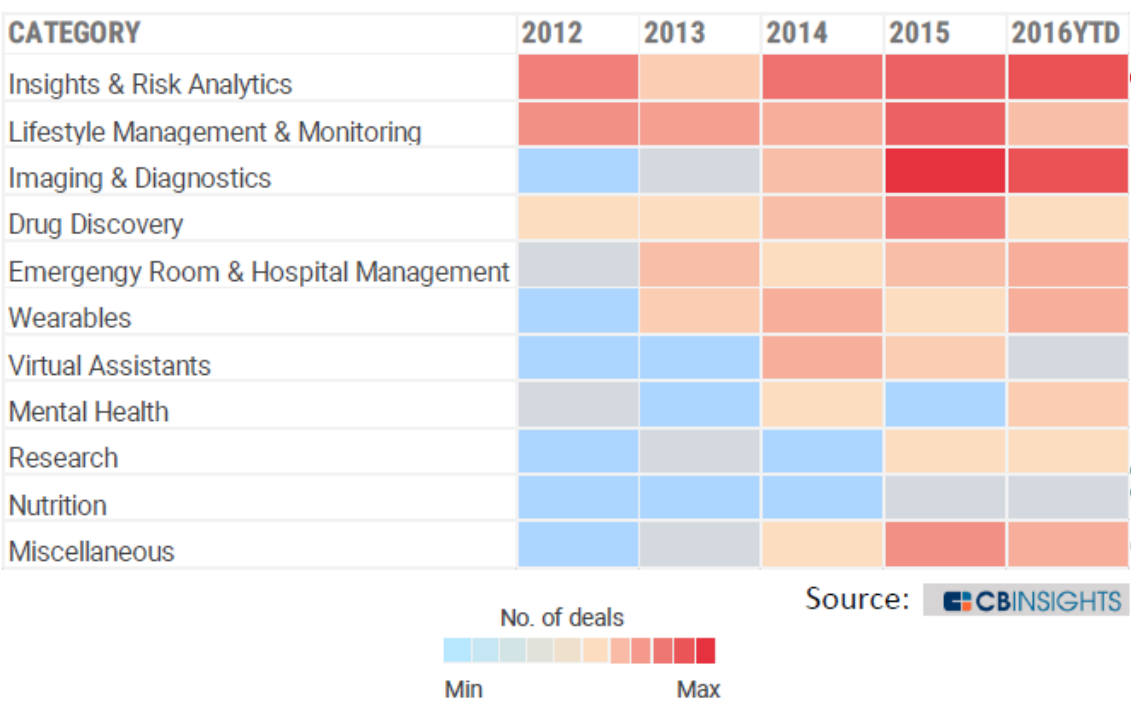


- All forces aligned now
- Baseline of progress to build upon

Healthcare Is Ripe For AI

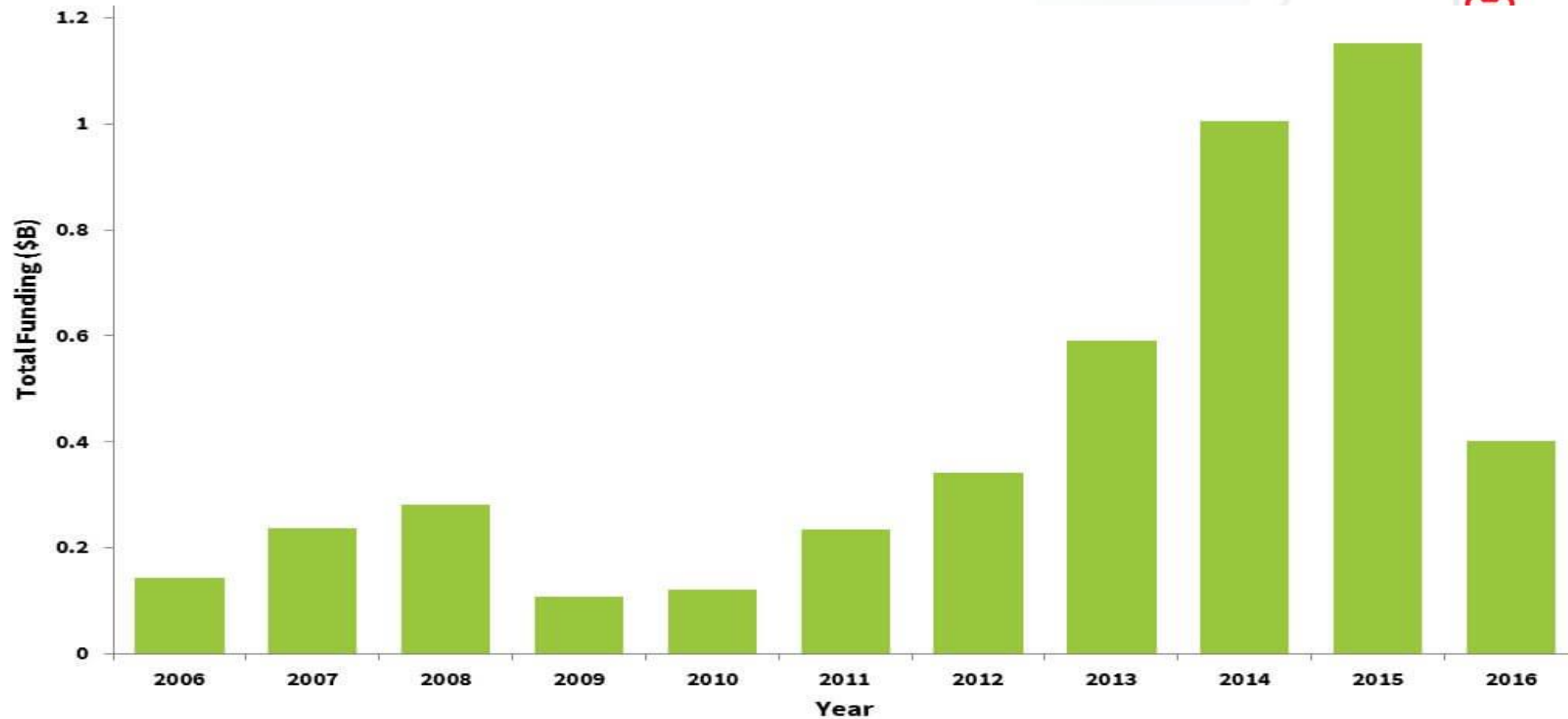


Healthcare emerging as ripe for AI investment



Within Healthcare, risk analytics and diagnostics

AI Investment Growing



<https://insights.venturescanner.com/tag/artificial-intelligence-company-list/>

Overview Only

This presentation will not go into detail on the extensive AI/CC/ML platforms and toolkits

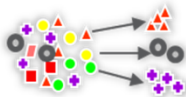
CLASSIFICATION

- Naïve Bayes
- Logistic Regression (GLM)
- Decision Tree
- Random Forest
- Neural Network
- Support Vector Machine
- Gaussian Mixture Models



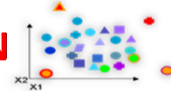
CLUSTERING

- Hierarchical K-Means
- Hierarchical O-Cluster
- Expectation Maximization (EM)



ANOMALY DETECTION

- One-Class SVM



TIME SERIES

- Single, Double Exp Smoothing

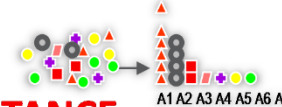
REGRESSION

- Linear Model
- Generalized Linear Model
- Support Vector Machine (SVM)
- Stepwise Linear regression
- Neural Network
- LASSO



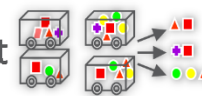
ATTRIBUTE IMPORTANCE

- Minimum Description Length
- Principal Comp Analysis (PCA)
- Unsupervised Pair-wise KL Div



ASSOCIATION RULES

- A priori/ market basket



PREDICTIVE QUERIES

- Predict, cluster, detect, features

SQL ANALYTICS

- SQL Windows, SQL Patterns, SQL Aggregates



FEATURE EXTRACTION

- Principal Comp Analysis (PCA)
- Non-negative Matrix Factorization
- Singular Value Decomposition (SVD)
- Explicit Semantic Analysis (ESA)

TEXT MINING SUPPORT

- Algorithms support text type
- Tokenization and theme extraction
- Explicit Semantic Analysis (ESA) for document similarity



STATISTICAL FUNCTIONS

- Basic statistics: min, max, median, stdev, t-test, F-test, Pearson's, Chi-Sq, ANOVA, etc.



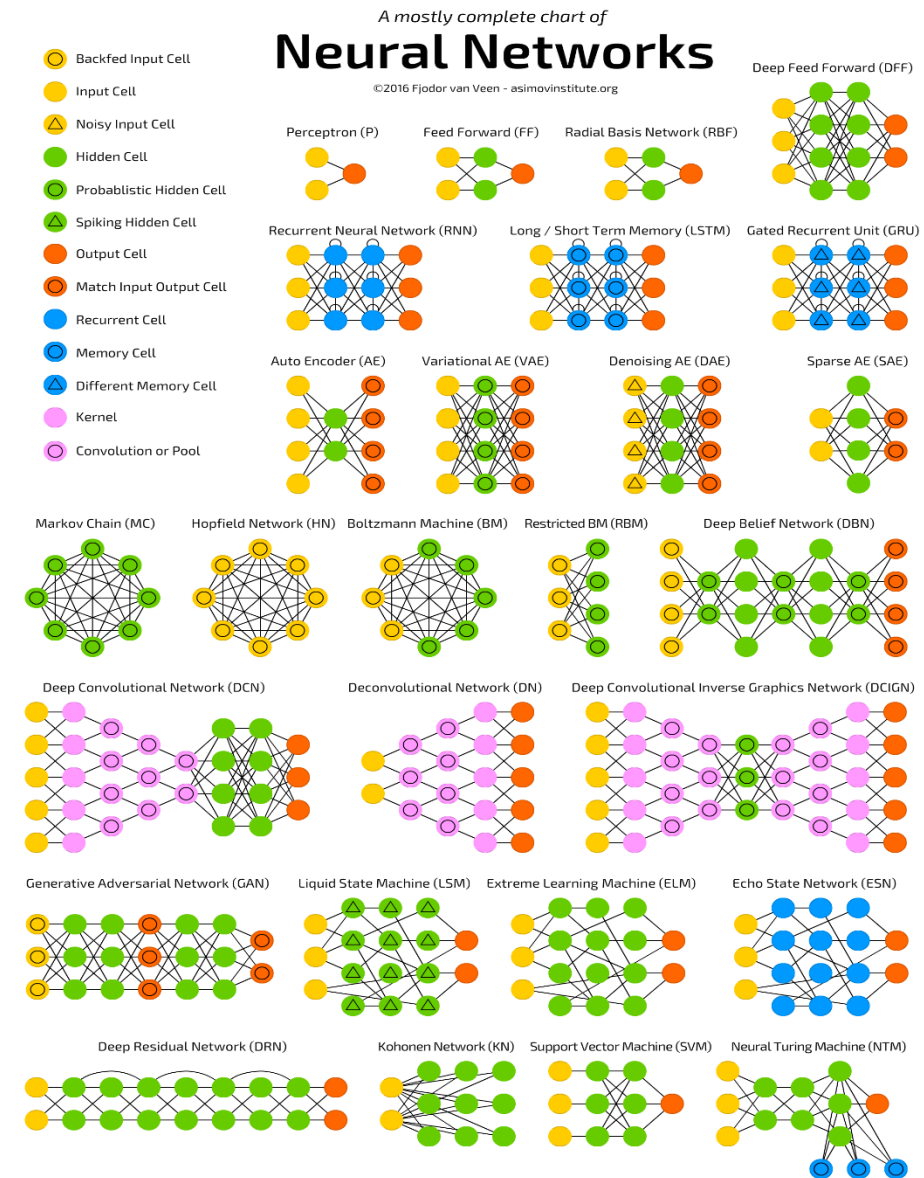
R PACKAGES

- CRAN R Algorithm Packages through Embedded R Execution
- Spark MLlib algorithm integration



When Not To Use

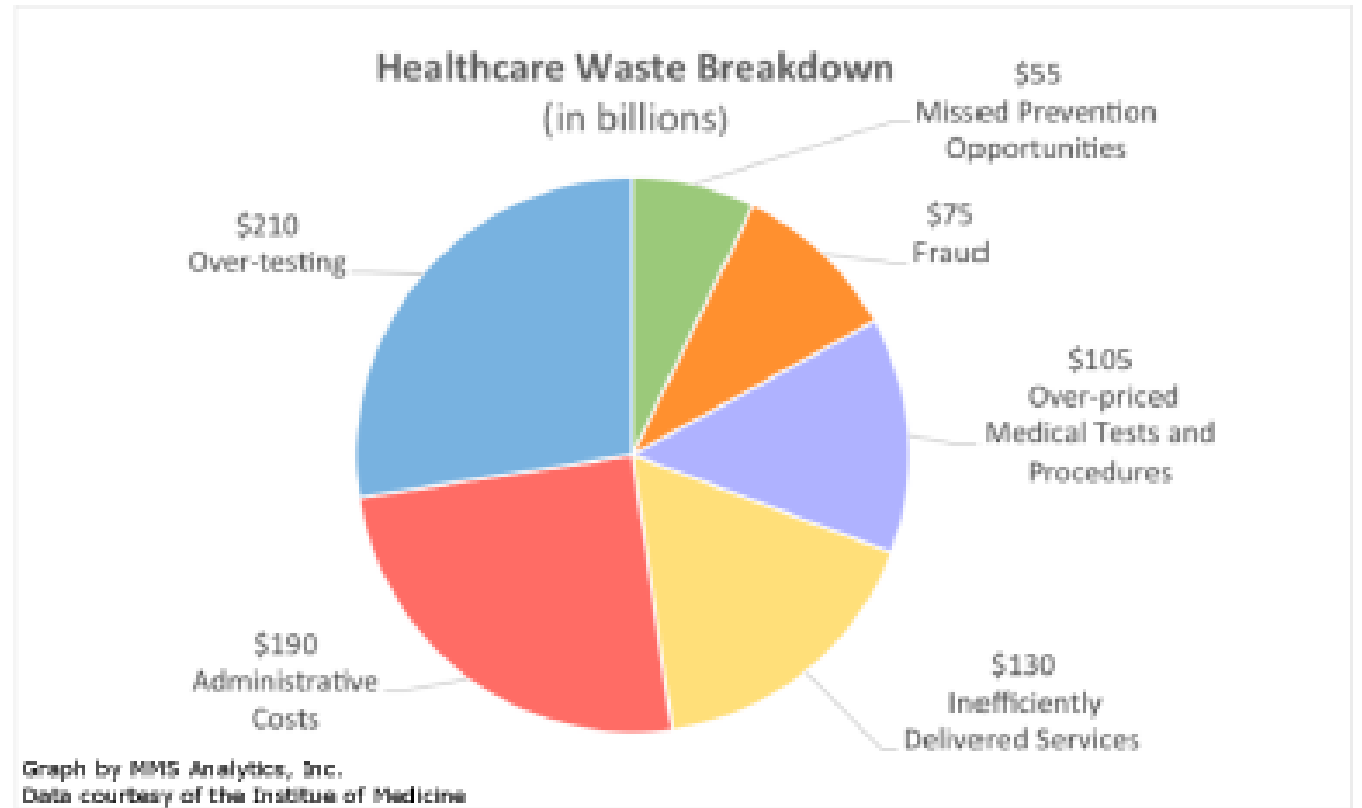
- Low-budget or low-commitment problems
- Interpreting and communicating model parameters/feature importance to a general audience
- Establishing causal mechanisms
- Learning from “unstructured” features



Recurrent Neural Networks (RNN) And Algorithmic Detection in Healthcare

Using aspects of AI to diagnose as well as an HCP

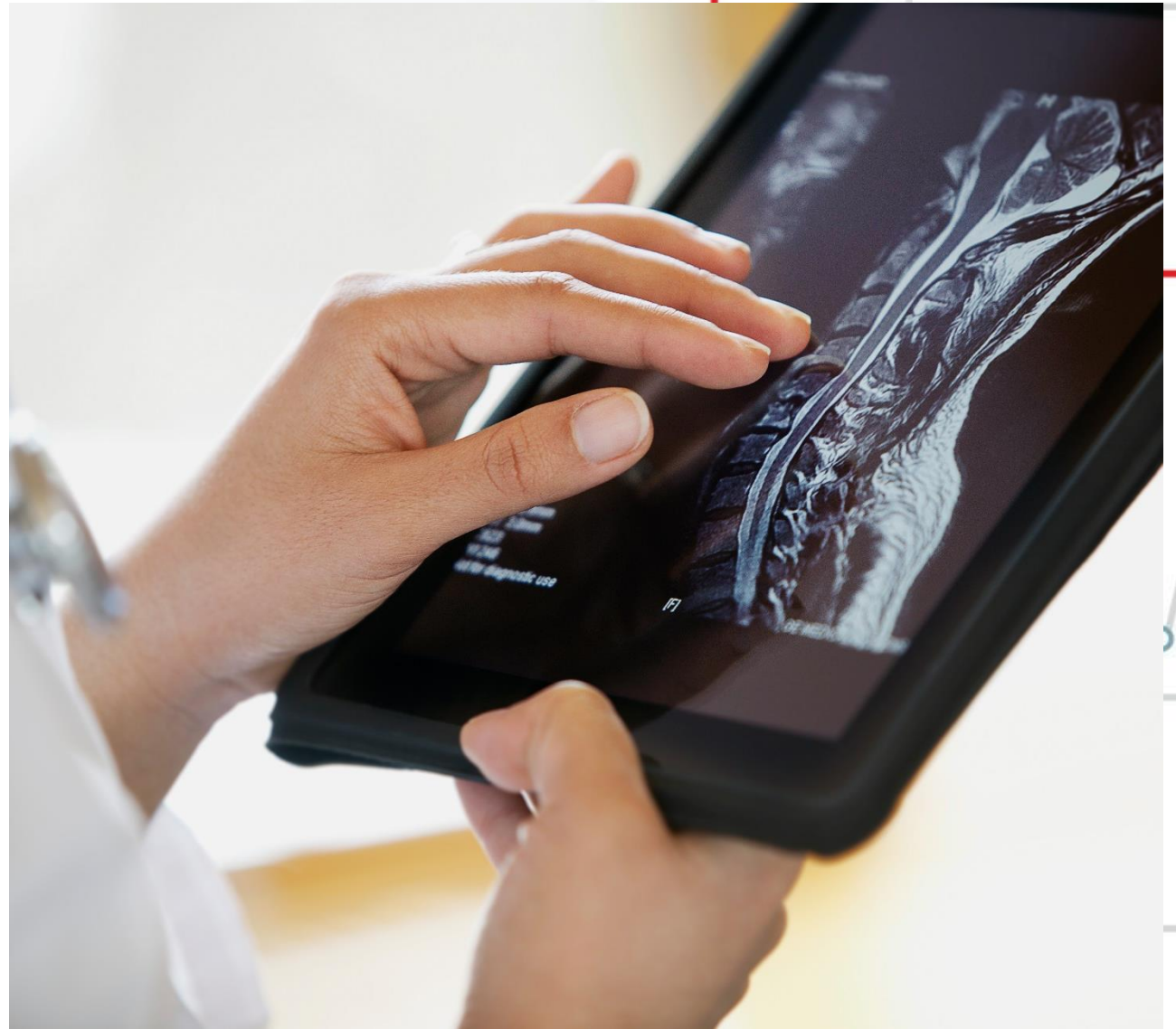
\$765 Billions



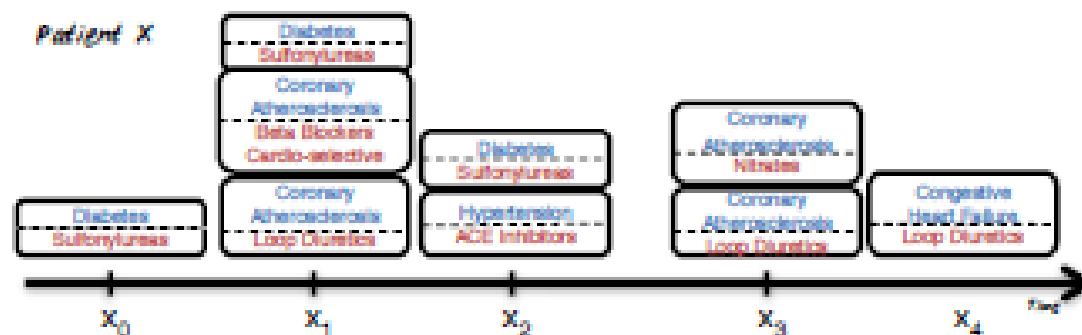
Human or AI Physician?

Doctor AI is a automatic diagnosis machine that predicts medical codes that occur in the next visit, while also predicting the time duration until the next visit.

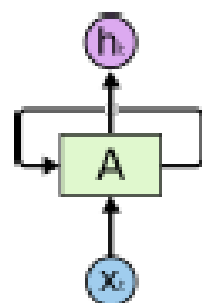
<https://github.com/mp2893/doctorai>



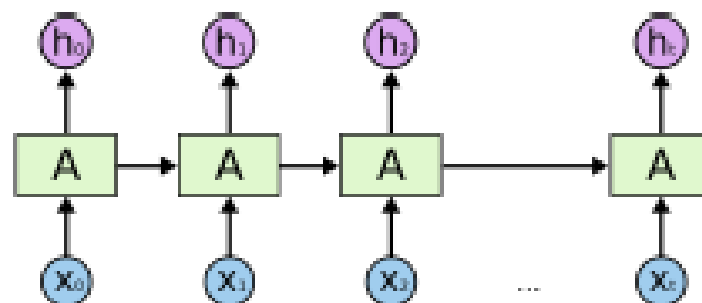
Study Conduct



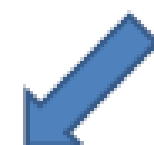
Event sequences



=



RNN model



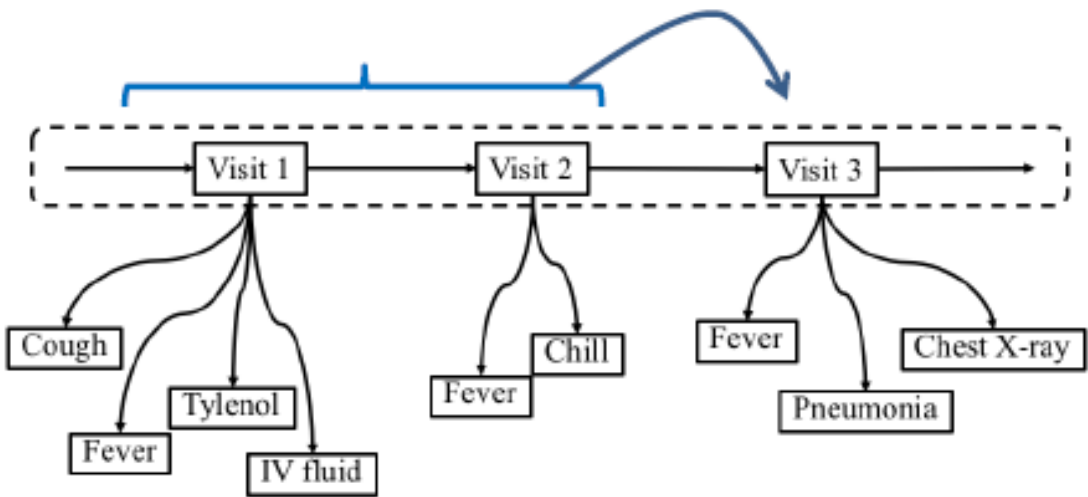
Risk Management

Safety Signal Detection

**Doctor
AI
Model**

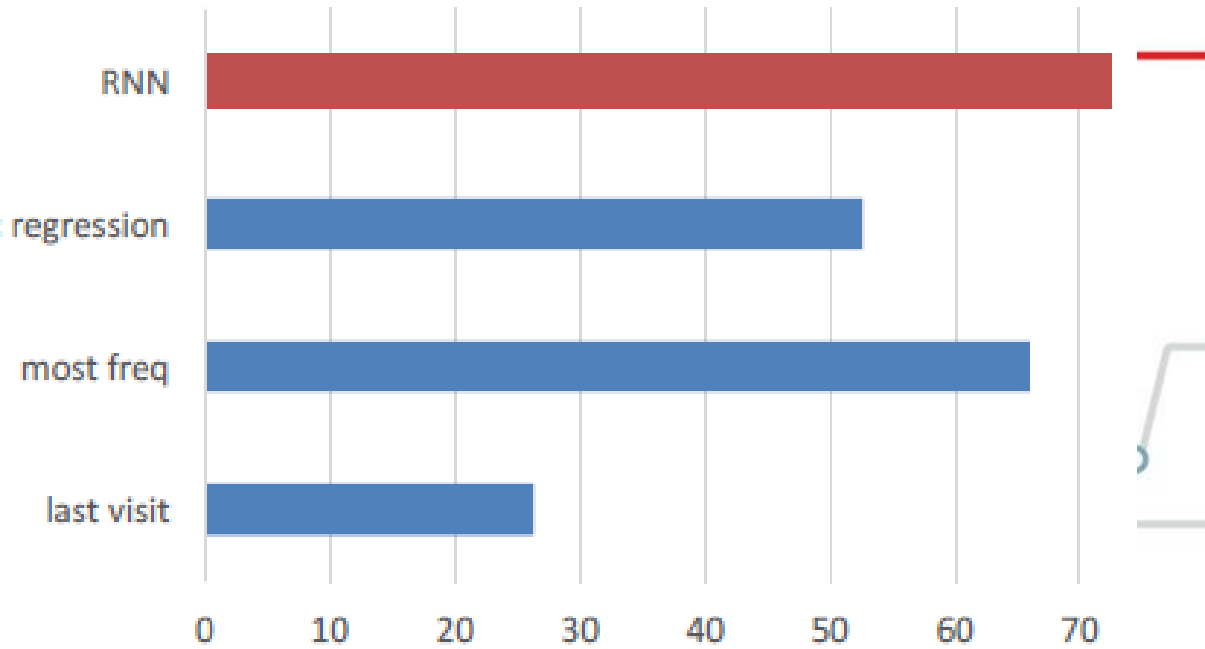
Study Conduct

Doctor AI Approach and Accuracy



top-*k* recall = $\frac{\text{\# of true positives in the top } k \text{ predictions}}{\text{\# of true positives}}$

Disease Progression Modeling



Predicting diagnoses in next visit



Deploying AI in Healthcare

Challenges

- Psychological – will patients “trust” a machine based diagnosis
- Black box architecture – do you understand the programming and the limitations
- Bias – machine awaits instructions and data given by a human

Opportunities

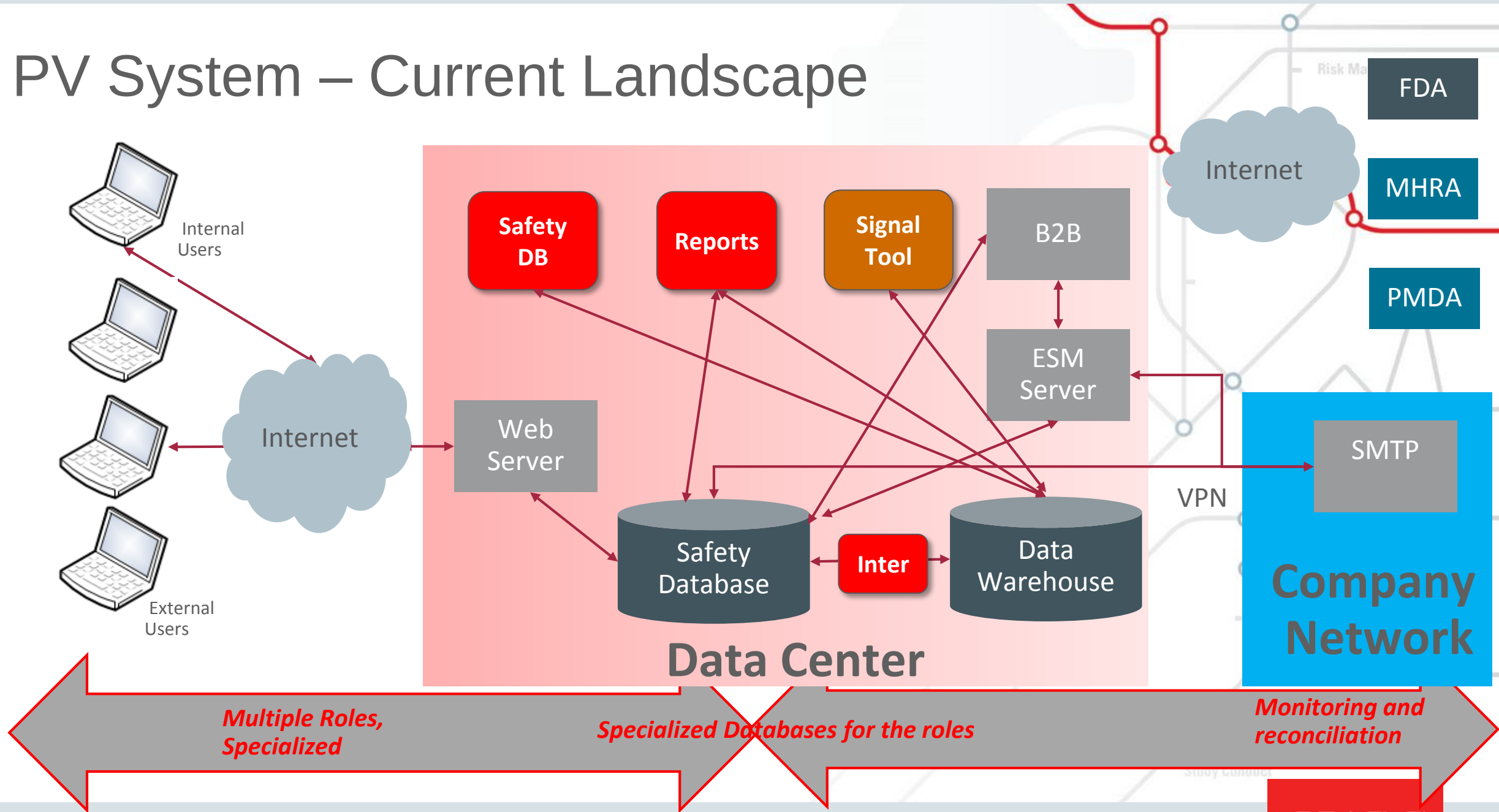
- Japanese researchers say AI can detect bowel cancer in **less than a second** – News story 30 Oct 2017
 - 94% Accuracy Rate
 - 30K images used for machine learning
 - “AI enables real-time optical biopsy of colorectal polyps during colonoscopy, regardless of the endoscopists' skill”

<http://www.zdnet.com/article/japanese-researchers-say-ai-can-detect-bowel-cancer-in-less-than-a-second/>

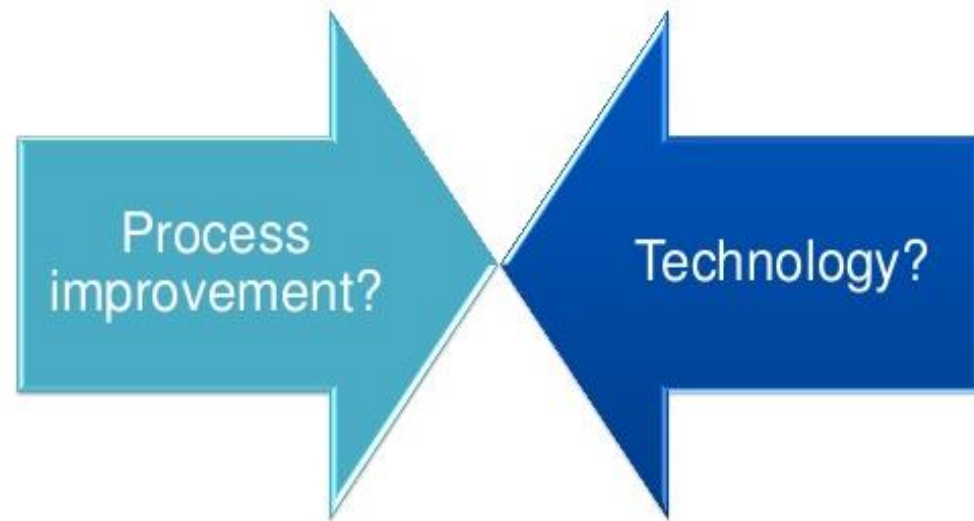
Drug Safety & Pharmacovigilance Pivot Point

Challenges and Opportunities for AI

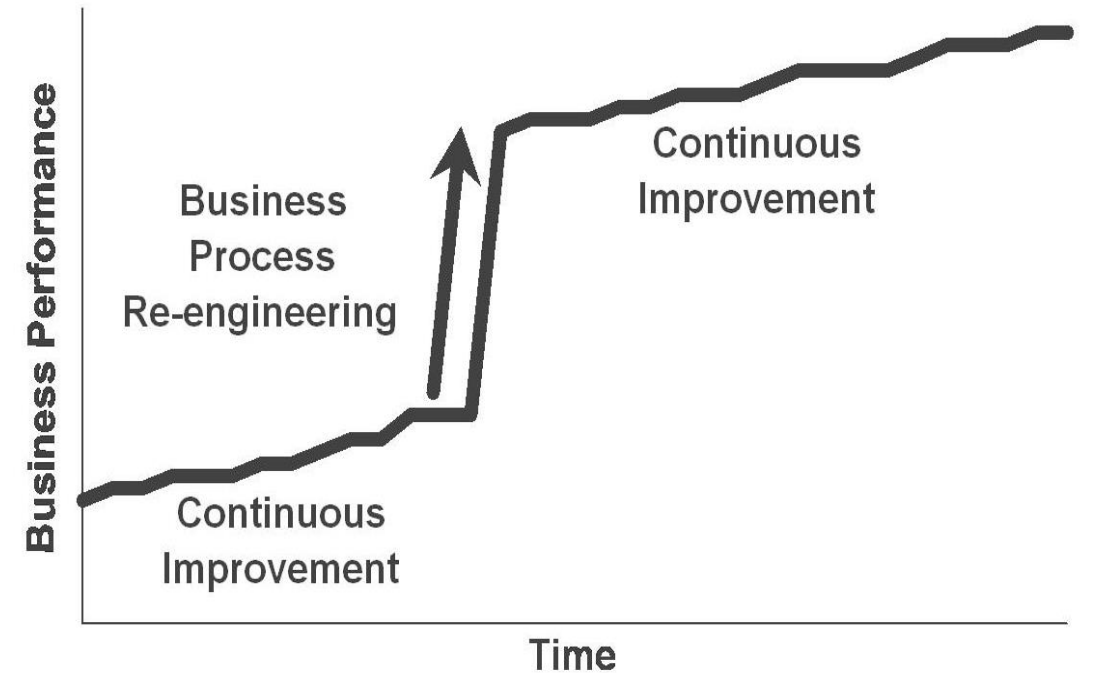
PV System – Current Landscape



Transformative Changes Require Best Practices With Technology Optimization



Process Improvement Meets Technology =
Transformation



- Business Process **Re-engineering** = Improved Workflow, Efficiencies, and Performance

Automations Available Today For Efficiency Gains

Intake	Enhanced Intake allows for bypassing of workflow steps
Data Entry	Data entry quality via pre-saves and post-saves validations
Narrative	Saving valuable time through auto generation
Letters	Leveraging technology to auto generate and distribute
Action Items	Improved efficiency through automated routing
Coding	Standardize coding through automated synonym list routing
Causality	Algorithmic based automation on assessments
Submission	Decreased maintenance via reporting rule configuration

Optimized PV Workflow + Automations = up to ½ FTE

Automation Decreases



Department
Budget



Processing
Time



Resource
Utilization



Back/Forth
Hand offs



Automation Increases



Case Analytics
& Metrics



Standardization
& Consistency



Quality &
Compliance



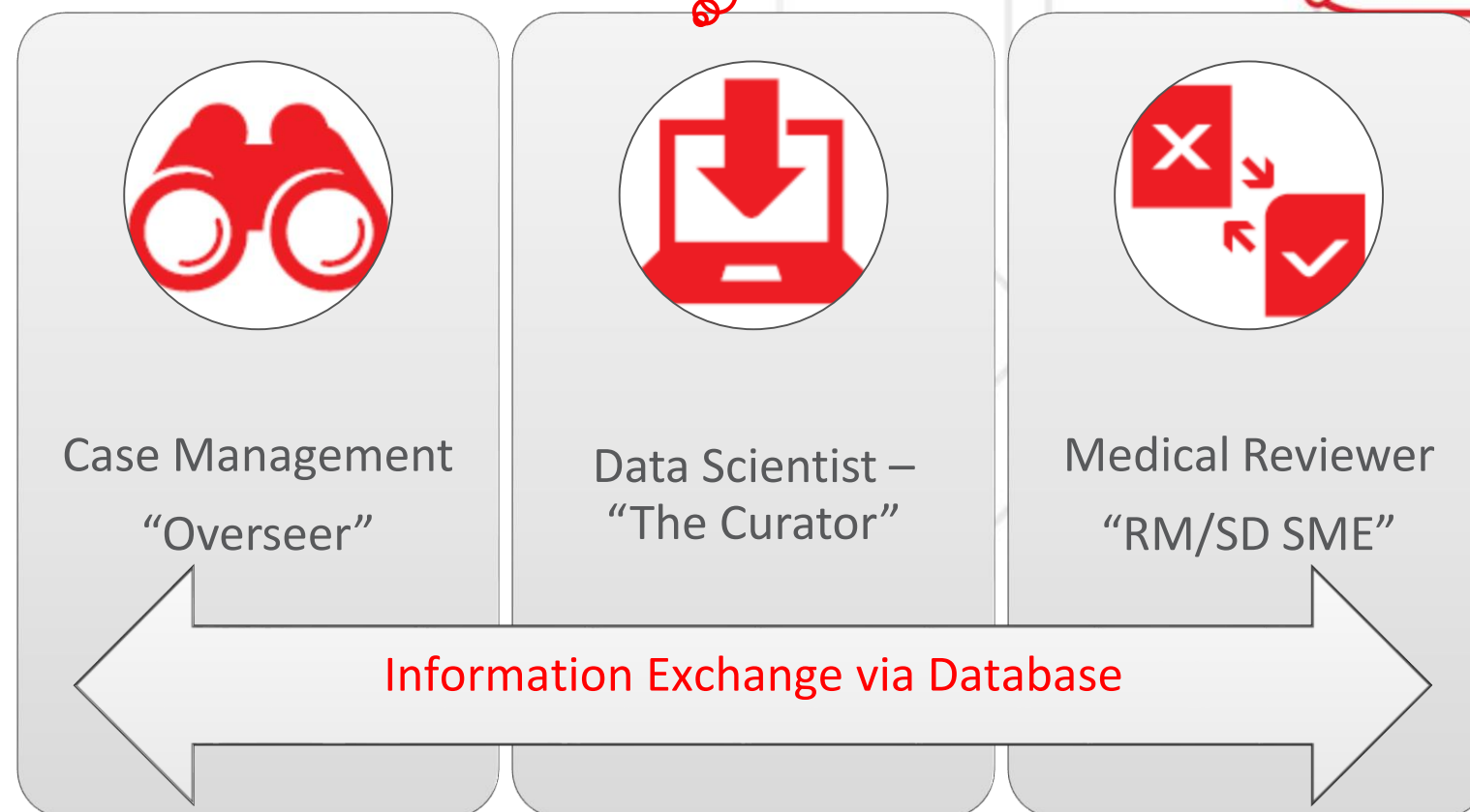
Proactive
Vigilance

Future of Pharmacovigilance

Aligning workflow with technology efficiencies

Assumptions:

- Data overload
- Case volume overload
- ICSRs commoditizing
- Require automations to regain processing efficiencies
- Need for regulatory compliance



Drug Safety & Pharmacovigilance AI

Challenges

- Validating changing lexical resources, such as internal IME and Core Data
- As ML validity expands, when to re-test system in an audit
- Structured versus Unstructured data and degree of subjective outlier association

Opportunities

- Apply group collective guidelines to new methodologies
- Risk mitigation and collaboration with regulatory agencies
- Plateau will be achieved in ML datasets but will undergo period of high risk and uncertainty



Navigating Through Technology For Actionable Insights

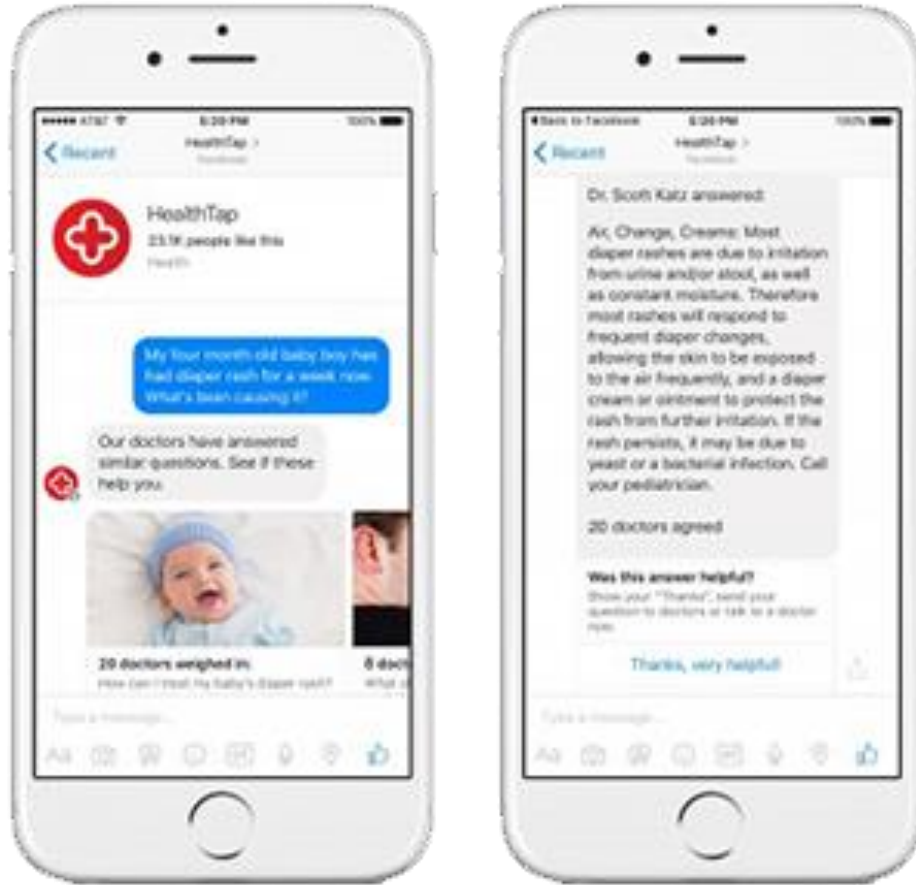
Bots Explained Briefly

```
=====
EEEEEEEE L      IIIIII ZZZZZZZ AAA
E        L      I      Z      A  A
E        L      I      Z      A  A
EEEEEE   L      I      Z      A  A
E        L      I      Z      AAAAAA
E        L      I      Z      A  A
EEEEEEEE LLLLLLL IIIIII ZZZZZZ  A  A
=====
ELIZA > (PLEASE TYPE IN ALL CAPS) WHAT'S YOUR NAME DEAR ?
AMIT
ELIZA > HI, I'M ELIZA. WHAT DO YOU WANT TO TALK ABOUT ?
AMIT > CAN I TALK ABOUT MY PROBLEM ?
ELIZA > SURE... !
AMIT > DUE TO ON GOING EXAMS IN COLLEGE, I HAVE A LOT OF STRESS.
ELIZA > PLEASE RELAX A LITTLE. SLEEP WELL.
AMIT > THANKS FOR YOUR ADVICE.
ELIZA > NO MENTION.
AMIT > BYE
ELIZA > BYE AND KEEP IN TOUCH...
=====
```

- ELIZA is an early natural language processing (NLP) computer program created from 1964 to 1966 at the MIT Artificial Intelligence Laboratory by Joseph Weizenbaum
- Simulated conversation by using a 'pattern matching' and substitution methodology that gave users an illusion of understanding
- **Chatbots are artificial intelligence systems that we interact with via text or voice interface**

Experience Eliza
<http://www.masswerk.at/elizabot/>

Modern Bots In Healthcare and Life Sciences



1. **Diagnosis assistance** — ask questions about their health. The chatbot then finds resources based on keywords from the user.
2. **Treatment reminders (adherence)** — the chatbots can offer to remind users to take their medications or refill their prescriptions
3. **Appointment scheduling** — Chatbots can link directly to portals to aid in scheduling doctors' appointments.
4. **Customized education** — Chatbots can also help train and educate users on a variety of topics.

Bot Caveats

Privacy

- HIPPA mandates to keep patient health conversations private

Compliance

- Use social media strategies to plan out associated risks

Adverse Events

- Will require human assistance to interact with complex inquiries

Cost

- Depends on complexity of programming

Integration

- Relate well with marketing and outreach initiatives

Sarcasm and Tone

- Will not be able to distinguish idioms or hidden meanings

<https://www.intouchsol.com/blog/chatbots-are-about-to-transform-facebook>

Successful Pharma Bots

- Launched in 2016, it is the first Chatbot for Physicians in Italy and across MSD
- Uses Facebook messenger
- Uses NLP and requires registration
- Immuno-Oncology focused for now
- Future plans to integrate with Siri, and other voice recognition systems

<http://www.impossibleminds.com/portfolio-item/msd/>

MSD launches MSD Salute BOT



FREE

Create and Deploy an NLP Bot

- will you give it NLP?
- will you make it simple or complex?
- will it reside on your website or FB?

Actionable Insight

- <https://recast.ai/docs/create-your-bot>
- [https://chatbotsmagazine.com/how-to-develop-a-chatbot-from-scratch-\[Beginners\]](https://chatbotsmagazine.com/how-to-develop-a-chatbot-from-scratch-[Beginners])

Start with Bot Builder

[Create your bot](#)

[Build your conversation](#)

[Connect your bot](#)

Start with the NLP API

[Create your bot](#)

[Train your bot](#)

[Text analysis API](#)

NLP Lexic

[Intent](#)

[Expression](#)

[Suggestion](#)

[Entity](#)

[Gazette](#)

[Language](#)

Bot Builder

[What is a skill?](#)

[Conditions](#)

[Triggers](#)

[Requirements](#)

[Actions](#)

[Conversation State](#)

[Code & Webhook](#)

Create your bot

Start with a template

To create a new bot, login and click on the link **+ NEW BOT** in the header section.

Select the first option "Create a complete chatbot".



Create a complete chatbot
with bot building tools



Analyse text and conversations
with the NLP API

Select pre-defined skills

You can choose one or several pre-defined skills you want to use as a starting point. You are free to modify them if you don't like them as such, or even delete them once you're ready to make your own.

If you want to fork them later on, they are available here: <https://recast.ai/scaffolder/starter-skills>



Greetings



Small talk



Weather

Create your bot

Finish your bot creation by:

Q&A

Sameer Thapar, PharmD
Global Pharmacovigilance Director
Oracle Health Sciences Consulting

[LinkedIn.com/in/Thapar](https://www.linkedin.com/in/Thapar)

