



Data Systems in Ophthalmology

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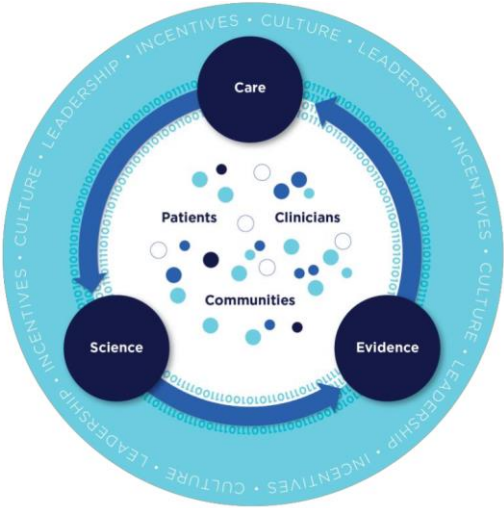
Overview

- **Real World Evidence**
- **Brief comment on Machine Learning**
- **Lessons to date**

Opportunities - Real World Evidence



RWE - Learning Health System



2012 – IOM, Best Care at Lower Cost The Path to Continuously Learning Health Care in America

RWE - Learning Health System (now)

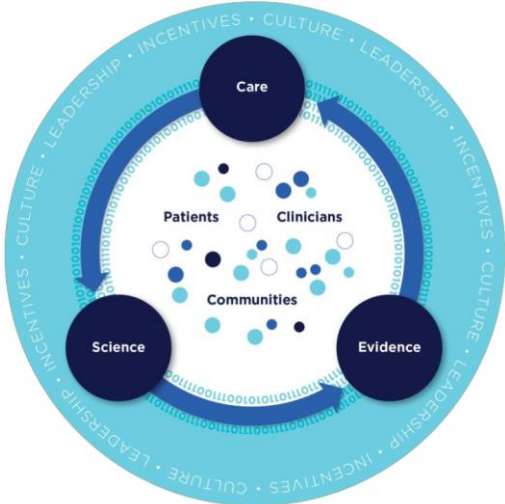


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Potential for RWE in Ophthalmology

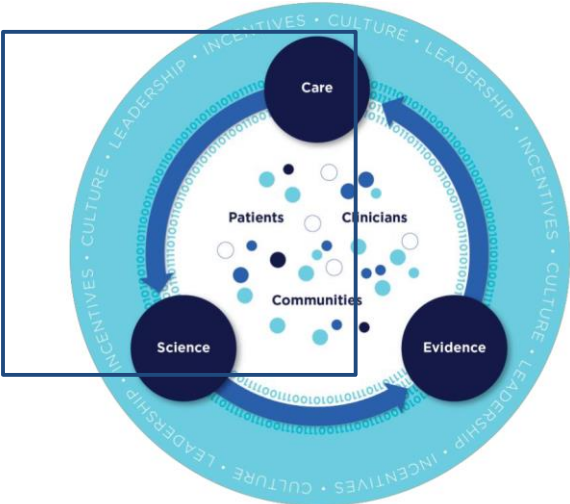
- Highly structured data in Ophthalmology
- Potential for pragmatic clinical trials
- Clear use cases
 - Large cohort analysis - e.g. Lucentis vs Avastin
 - Small cohort analysis - enable rare disease approvals
- Potential for patient generated data

RWE - Learning Health System



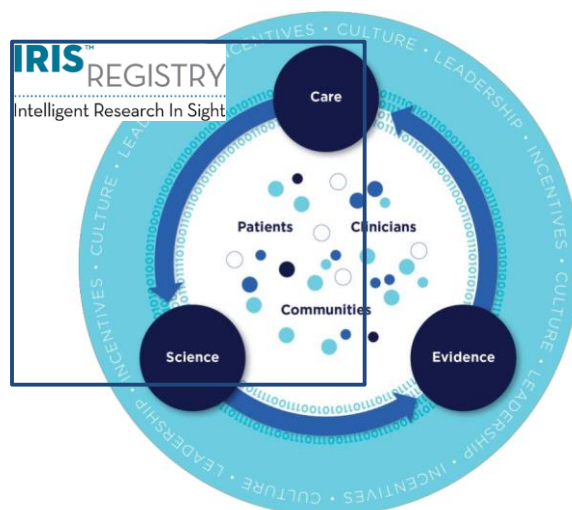
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RWE - Learning Health System



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Regulatory Lessons from Oncology

- Data and Output need to be transparent
- Need for careful cohort selection
- Pre-specified analysis plan
- Culture / Incentives are critical

Opportunities - Machine Learning



Traditional and “New” AI

The old way:

Write a computer program
with *explicit rules* to follow

```
if email contains V!agrå  
  then mark is-spam;  
  
if email contains ...  
  
if email contains ...
```

The new way:

Write a computer program to
learn from examples

```
try to classify some emails;  
  change self to reduce errors;  
repeat;
```

Deep Learning Revolution

Modern Reincarnation of Artificial Neural Networks

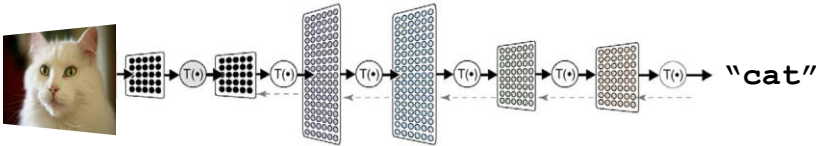
Collection of trainable mathematical units, organized in layers, that work together to solve complicated tasks

What's New

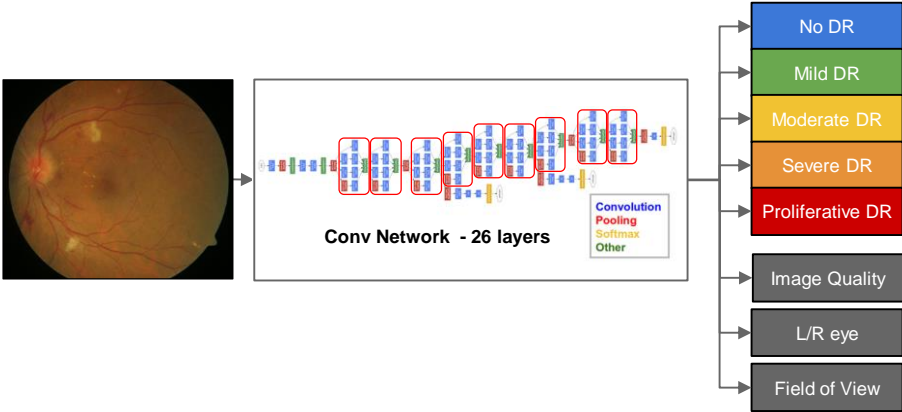
layered network architecture, new training math, *scale*

Key Benefit

Learns features from raw, heterogeneous data
No explicit feature engineering required



Adapt deep neural network to read fundus images



Jama 12/01/16

AI Effect

- “Intelligence is whatever machines haven't done yet” - Larry Tessler (~1970)
- When an AI application works it tends to get characterized as an advance in another field.



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