Delivering Clinical Lab 2.0 Evidence Base: Lab Initiated Care Model

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CLINICAL LAB 2.0
A PROJECT SANTA FE FOUNDATION INITIATIVE

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CLINICAL LAB 2.0

The Pillars of Project Santa Fe

Create a disruptive value paradigm and explore alternative business models that expand the role of diagnostic services in the future healthcare ecosystem

| CL2.0 Leadership Foundation	CL2.0 Business Model Standards	CL2.0 Evidence Demonstration

• What is Leadership in Value-based Healthcare?
• Outside the lab
• CL2.0 Skillset
• CL2.0 Knowledge set
Know Self; Know Terrain
• Communication is key
	• CL2.0 Objectives & Key Results
	• Measure what matters – Quad Aim
	   • Clinical
	   • Business/Financial
	   • IT/Data
	   • Product (MVP)
	• Health Economics, Population Health, Value based Care
		• CL2.0 Multi-Institutional Demonstration Projects
		• Outcome focused – Clinical & Economic
		• Case studies, best practices & lessons learned
		• Publish – peer review & skunkworks

CL2.0 Partnerships

Objectives
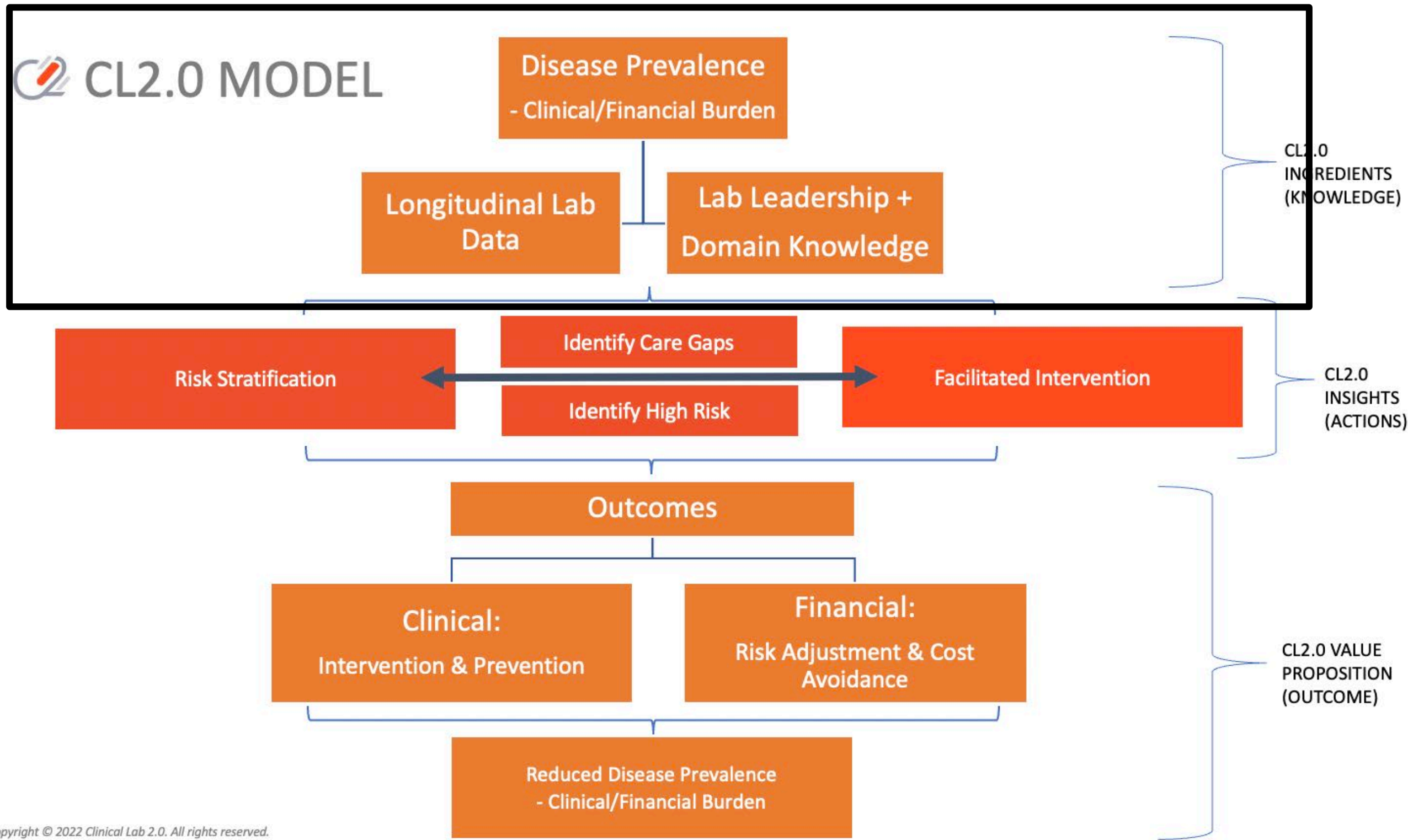
- Highlight CL2.0 Evidence

    - Clinical Lab 2.0 Model

    - Demonstration Projects and Care Model

- Discuss Clinical Lab 2.0 Recommendations for Laboratories

- Role of the Laboratory Industry

Lab's Role in Improved Outcomes
CL 2.0 Model
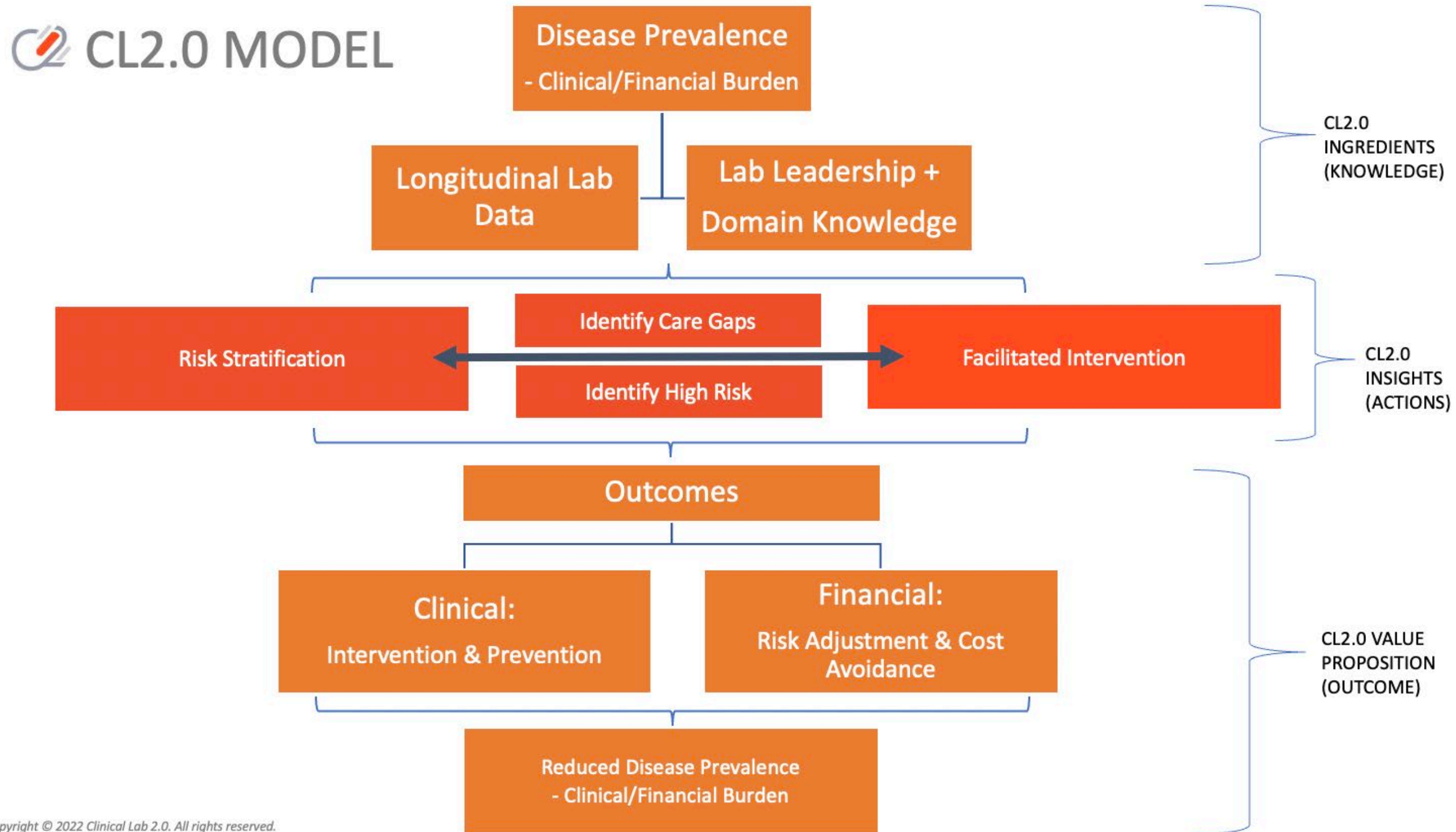
Lab's Role in Improved Outcomes
Applying the CL 2.0 Model

- **High prevalence conditions**
- **Laboratory Leadership**
- **Key Partnerships**
  - Physician, Administrative, Payer champion

Lab's Role in Improved Outcomes Applying the CL 2.0 Model

CL2.0 MODEL

Disease Prevalence
- Clinical/Financial Burden

Longitudinal Lab Data

Lab Leadership + Domain Knowledge

CL2.0 INGREDIENTS (KNOWLEDGE)

Risk Stratification ← **Identify Care Gaps / Identify High Risk** → **Facilitated Intervention**

CL2.0 INSIGHTS (ACTIONS)

Outcomes

Clinical: Intervention & Prevention

Financial: Risk Adjustment & Cost Avoidance

CL2.0 VALUE PROPOSITION (OUTCOME)

Reduced Disease Prevalence
- Clinical/Financial Burden

- **Clinical Protocols**
  - Testing cascade; diagnostic pathway
- **Workflow & facilitated interventions**

Lab's Role in Improved Outcomes Applying the CL 2.0 Model
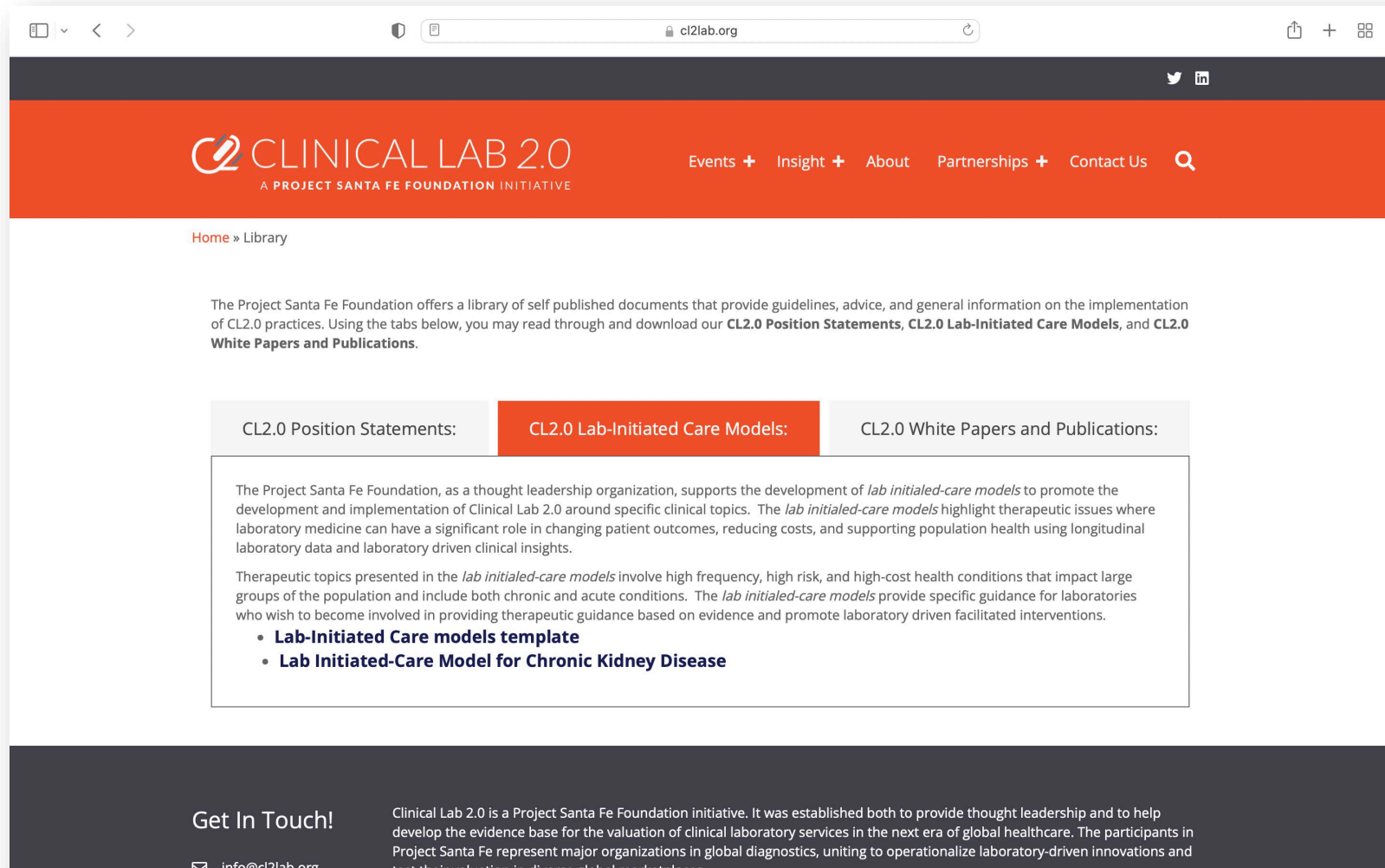
- Shared accountability
- Measurable and attributable outcomes
- Policy impacting clinical protocols & workflow

Lab Driven CL2.0 Care Models

- *Lab driven care models* :
  - **promote the development and implementation of Clinical Lab 2.0 around specific clinical topics**

  - **highlight therapeutic issues where laboratory medicine can have a significant role in changing patient outcomes**

Demonstration Project Updates

Funded Demonstration Projects 2024

SURVIVE:
Sepsis Under Review: Value of Interdisciplinary interVentions and Evidence Colloquium Update (2017-2023)

Stronger together: multi-site project PILOT

- **Site Investigators: Aya Haghamad, Jordan Law, Michael Sheehan, Bob Tibbetts, Ann Marie Tice, Ivana Vaughn, Donna M. Wolk**

- **Geisinger, Henry Ford, and Northwell Health**

Demonstration Project Framework

- **CL 2.0 insights should include identification of ...**

- **Analytical Framework:** For hospitalized in-patients (IP) with bloodstream infections (BSI), lack of timely identification of the microorganisms (ID) in preventable adverse patient outcomes [(e.g., mortality and length of hospital stay (LOS)]

HIGH-RISK POPULATIONS, E.G. HIERARCHICAL CONDITION CATEGORY (HCC)

CARE GAPS

INSIGHTS TO FACILITATED "DIAGNOSTIC INTERVENTIONS"
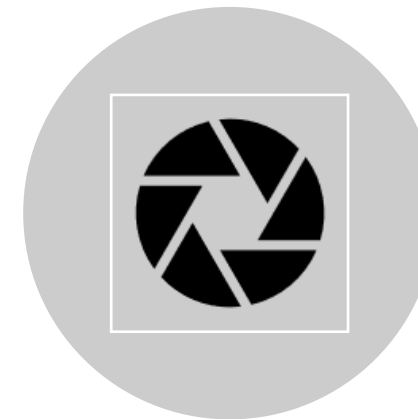
DOWNSTREAM CLINICAL, OPERATIONAL, FINANCIAL, AND QUALITY METRIC IMPACT
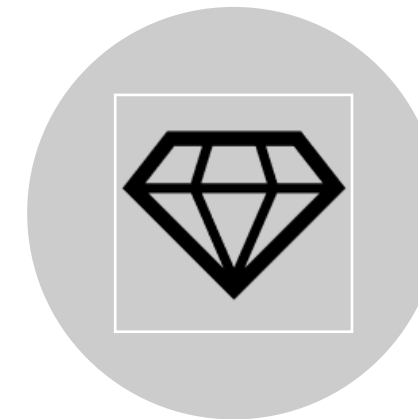
ADDING VALUE TO VALUE-BASED CARE (VBC)

Objective 1: Pilot Funding, Project Santa Fe Foundation

- Rapid pathogen detection in blood cultures

- The SURVIVE team aims to build a multisite data set
  to assess a test-based diagnostic intervention
  and document downstream impact and value
  while identifying care-gaps that will jeopardize long-term improvements

Study Design, Retrospective Cohort Study
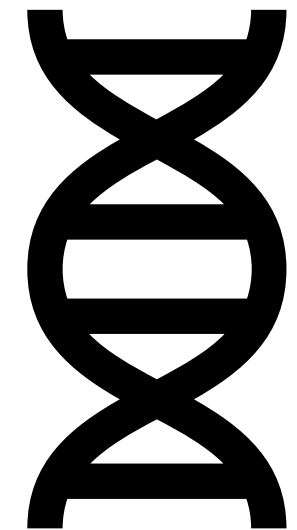
- **Aim:** Evaluate impact of rapid testing for bacteremia vs. sepsis, distinguished by ICD-9 and 10 codes for sepsis (limitation = coding flaws)

PICOTS

Exclusion: Subjects with LOS as day 0-1; BCID cannot assist if death occurs before a positive BC and rapid test can occur

Population: Subjects with a Positive Blood Culture (BC), n = 3000 each site	
Intervention: Molecular Testing of Positive BC	
Comparator: Routine Phenotypic Microbiology	
Outcomes: Clinical and Operational Variables (e.g., Mortality, LOS)	
Timing: 1 Year Pre- and 1Year Post-intervention	
Setting: 3 PSF Healthcare organizations	

Demonstration Project Timeline

COVID-19 - imposed delays, but SURVIVE Project did survive

| 2017; Commonalities Competencies | → | 2018; Expt. Design, Framework, Risk Stratification; Data Governance | → | 2019-2022 Pandemic | → | 2023 Funding RedCap Cloud | → | 2024 Multi-Site Pilot Data |

Demonstration Project Status Report

- **Recent Progress**

  - Data dictionary to mapped pilot set of multi-site demographic and clinical variables (40 of > 609)

  - Purchased Red Cap Cloud (RCC) with a PSF grant, for evaluation and potential adoption, 1 year access

  - IRB: Each site has access to their own data in full, quality grant per IRB

  - Data governance: Each site has DUA with Geisinger to house data without PHI for data concatenation

  - Trained in RCC, created RCC data intake forms, validated upload from each site, combined data, curating combined data sets

Step 1: Data Dictionary
40 basic variables in Pilot
> 600 overall
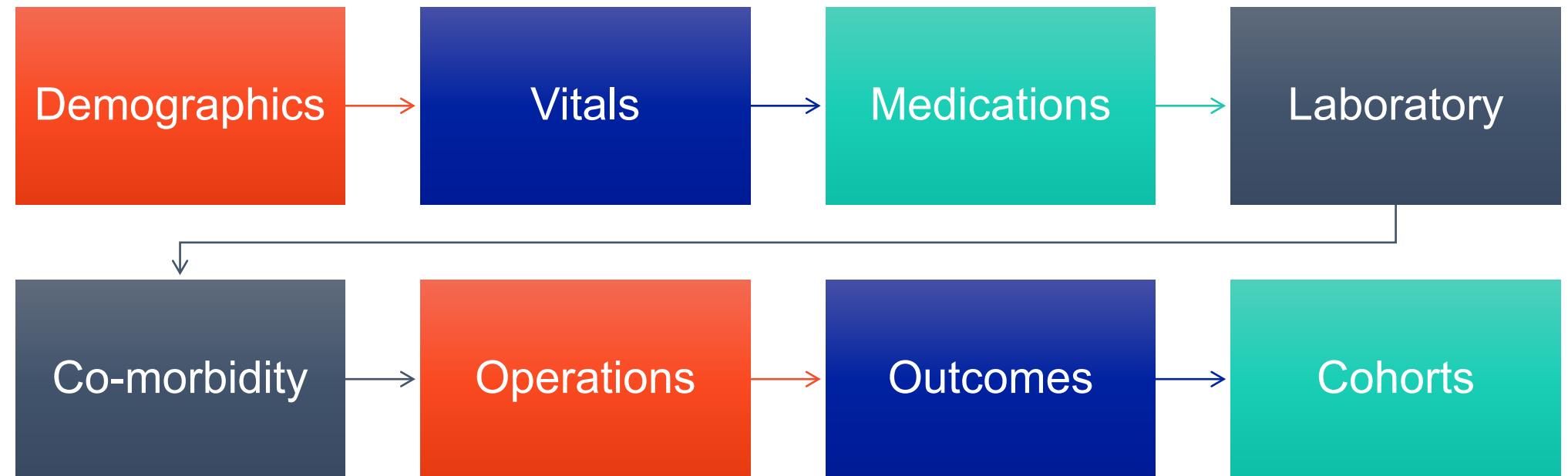
	Variable / Field Name	Field Type	Field Label	Group Name
1	Variable / Field Name	Field Type	Field Label	Group Name
2	{}			
3	DEMO_PTID	text	Patient ID	Demographics
4	DEMO_SEX	text	Sex	Demographics
5	DEMO_AGE	Number Box (Decimal)	Age	Demographics
6	VIT_RR	Number Box (Integer)	Respiratory Rate	Vitals
7	VIT_HR	Number Box (Integer)	Heart Rate	Vitals
8	VIT_TEMP	Number Box (Decimal)	Temperature (Fahrenheit)	Vitals
9	VIT_SBP	Number Box (Integer)	Systolic Blood Pressure	Vitals
10	VIT_DBP	Number Box (Integer)	Diastolic Blood Pressure	Vitals
11	MED_ABX48H	Number Box (Integer)	Antibiotic within 48h	Medications
12	MED_VASO	Number Box (Integer)	Vasopressor	Medications
13	LAB_LEUKO	Number Box (Integer)	Leukocytosis	Laboratory
14	LAB_ABSNEUTS	Number Box (Decimal)	Absolute Neutrophils	Laboratory
15	LAB_ABSLYMPHS	Number Box (Decimal)	Absolute lymphocyes	Laboratory
16	LAB_LAC	Number Box (Decimal)	Lactate	Laboratory
17	LAB_CULT48H	Number Box (Integer)	Culture within 48h?	Laboratory
18	COMOR_HTN	Number Box (Integer)	History of Hypertension?	Comorbidities
19	COMOR_CA	Number Box (Integer)	History of Cancer?	Comorbidities
20	COMOR_CKD	Number Box (Integer)	History of Chronic Kidney Disease?	Comorbidities
21	COMOR_LIVDZ	Number Box (Integer)	History of Liver Disease?	Comorbidities
22	COMOR_PULM	Number Box (Integer)	History of Chronic Pulmonary Disease?	Comorbidities
23	COMOR_CHF	Number Box (Integer)	History of Congestive Heart Failure?	Comorbidities
24	COMOR_DEMENT	Number Box (Integer)	History of Dementia?	Comorbidities
25	COMOR_MYELO	Number Box (Integer)	History of Myeloma?	Comorbidities
26	COMOR_LEUK	Number Box (Integer)	History of Leukemia?	Comorbidities
27	COMOR_LYMPH	Number Box (Integer)	History of Lymphoma?	Comorbidities
28	COMOR_DM	Number Box (Integer)	History of Diabetes Mellitus?	Comorbidities
29	COMOR_COPD	Number Box (Integer)	History of Chronic Obstructive Pulmonary Disease?	Comorbidities
30	COMOR_MI	Number Box (Integer)	History of Myocardial Infarction?	Comorbidities
31	COMOR_NEUTRO	Number Box (Integer)	History of Neutropenia?	Comorbidities

32	OPER_ICUD	Number Box (Decimal)	ICU days?	Operations
33	OPER_VENTD	Number Box (Decimal)	Ventilator days?	Operations
34	OPER_LOSICU	Number Box (Decimal)	LOS ICU?	Operations
35	OPER_LOS	Number Box (Decimal)	LOS?	Operations
36	OPER_LABTEST	Number Box (Decimal)	Number of laboratory tests?	Operations
37	OPER_IPMORT	Number Box (Integer)	Inpatient mortality?	Operations
38	OPER_30DMORT	Number Box (Integer)	30-day mortality?	Operations
39	OPER_30DPREADMIT	Number Box (Integer)	30-day preadmission?	Operations
40	OPER_30DREADMIT	Number Box (Integer)	30-day readmission?	Operations
41	OPER_SERV	text	Service?	Operations
42	OPER_PREPOST	text	Pre_Post?-	Cohort
43	OPER_SEPICD	Number Box (Integer)	Sepsis ICD y/n?	Cohort

Step 2: RedCap Cloud Software

Before Purchase

Software IT Security

IRB, PHI, Data Governance

Data Use Agreements

Location of housed Software

Secure FTP protocols

After Purchase

Software training

Harmonized tool construction

Data extraction from each site

Data concatenation

Data curation and quality checks

Data analysis

Bias

Confounders

![CLINICAL LAB 2.0 - A PROJECT SANTA FE FOUNDATION INITIATIVE]

Step 3:
Missingness Site A/B, Imputation or Not?

Site A
Total missingness = 26%
Total of subject missing > 1 feature = 78/3000 = **2.6%**

Site B
**Total missingness = 81%**
Total of subject missing > 1 feature = 1563/3000 = **52%**

Count	Number of columns missing	Patterns
2206	0	0000000000000000000000000000000000000000000
716	1	0000000000010000000000000000000000000000000
17	2	0000000000110000000000000000000000000000000
16	3	0000000000111000000000000000000000000000000
1	3	0000000001110000000000000000000000000000000
2	4	0000000001111000000000000000000000000000000
38	5	0000000001111000000000000001000000000000000
1	1	0000100000000000000000000000000000000000000
1	5	0000100001111000000000000000000000000000000
1	10	0011011001111000000000000001001000000000000
1	11	0011111001111000000000000001001000000000000

Count	Number of columns missing	Patterns
581	0	0000000000000000000000000000000000000000000
849	2	0000000000000000000000000011000000000
4	3	0000000000000000000000000011000000100
366	1	0000000000000100000000000000000000000
1083	3	0000000000000100000000000011000000000
3	4	0000000000000100000000000011000000100
20	3	0000010000000000000000000011000000000
2	4	0000010000000000000000000011000000100
42	4	0000010000000100000000000011000000000
3	5	0000010000000100000000000011000000100
1	2	0001000000000100000000000000000000000
8	4	0001000000000100000000000011000000000
1	4	0001010000000000000000000011000000000
1	6	0001010000000100000000000011000000100
1	3	0001100000000100000000000000000000000
1	5	0001100000000100000000000011000000000
2	5	0001110000000000000000000011000000000
16	6	0001110000000100000000000011000000000
16	7	0001110000000100000000000011000000100

Demographics, Sex by Site

Mean Age, +/- SEM Statistically Different P < 0.001
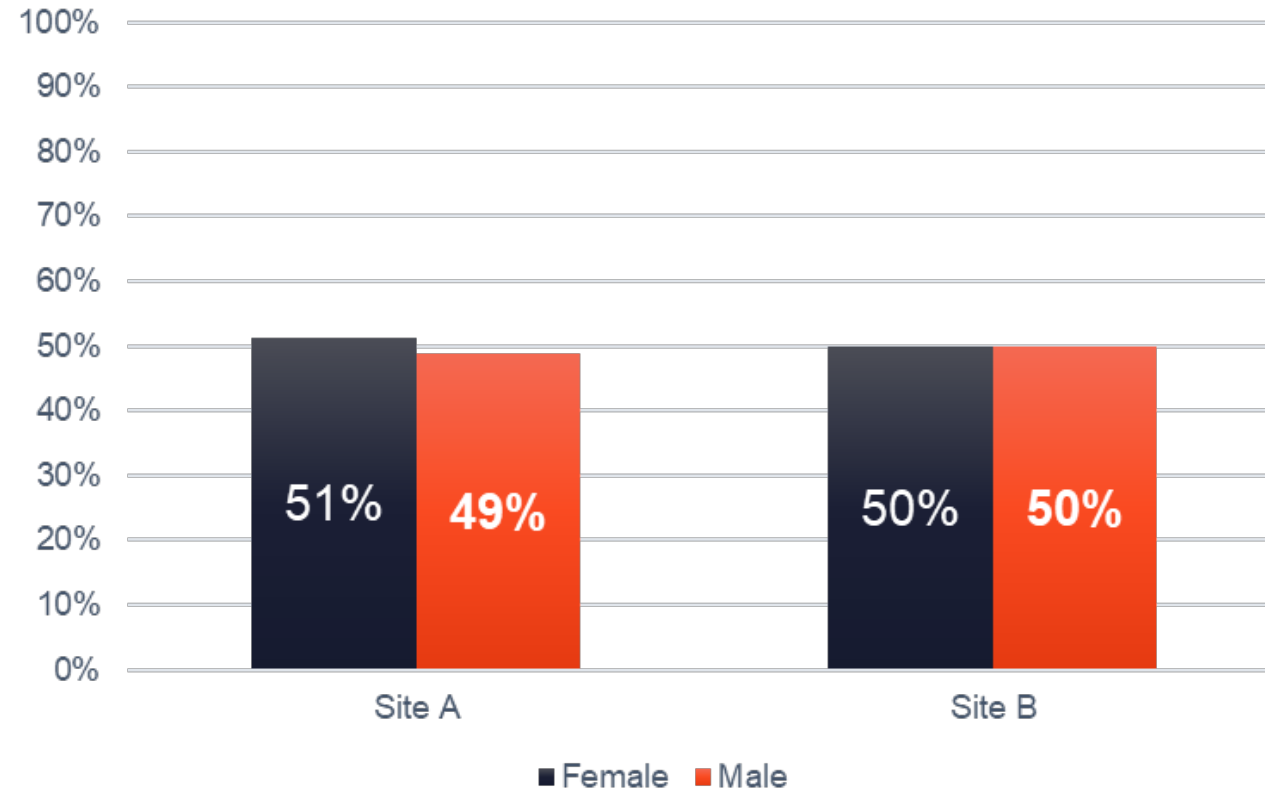
3 of 14 DRG Comorbidities are Not Significantly Different
Dementia
Myeloma
Leukemia
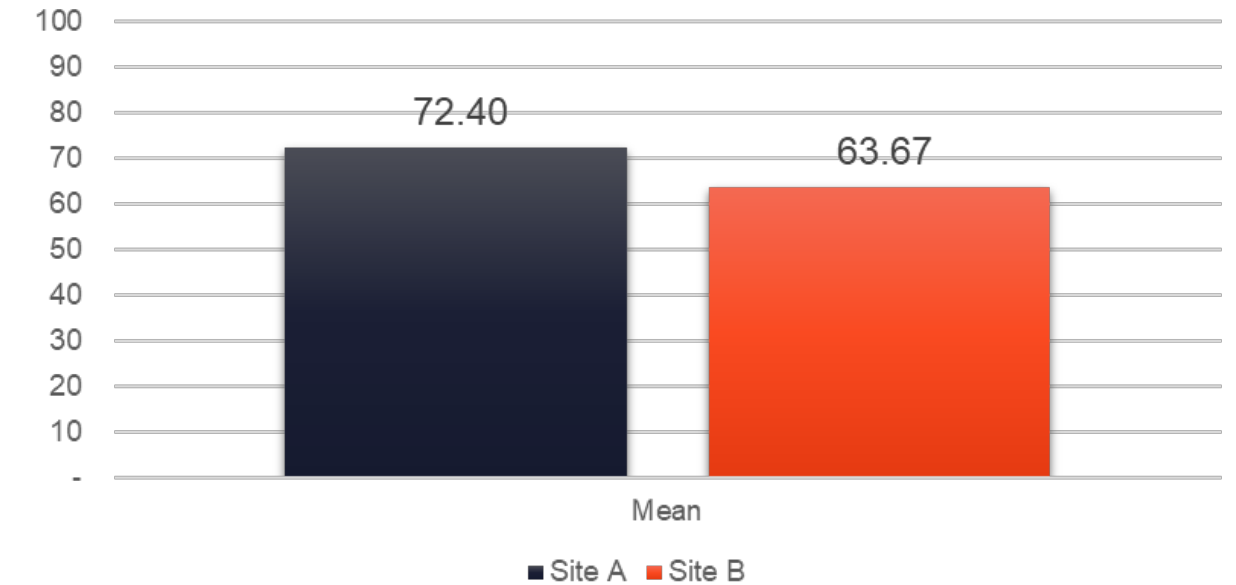
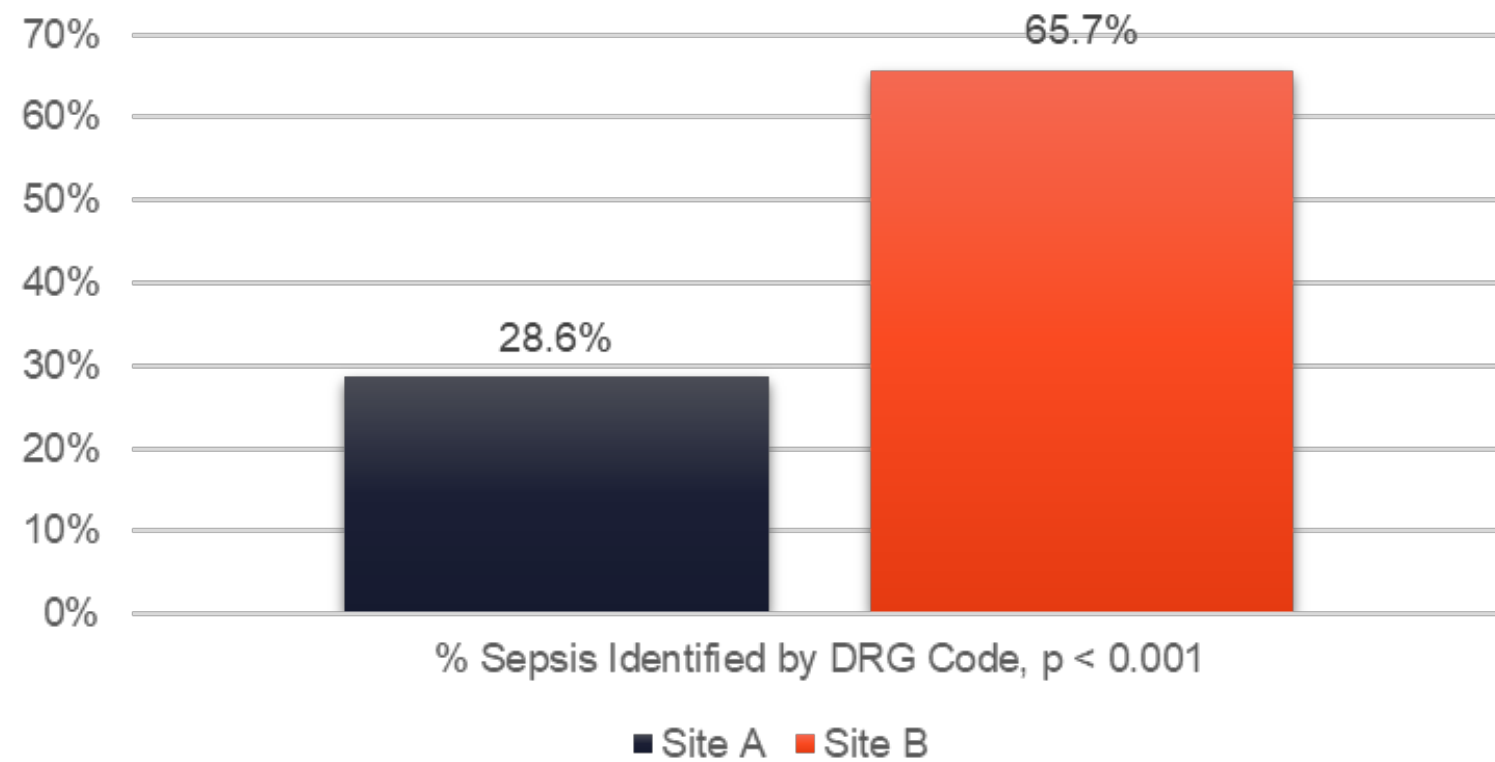**11/14 DRG Comorbidities, P < 0.001**
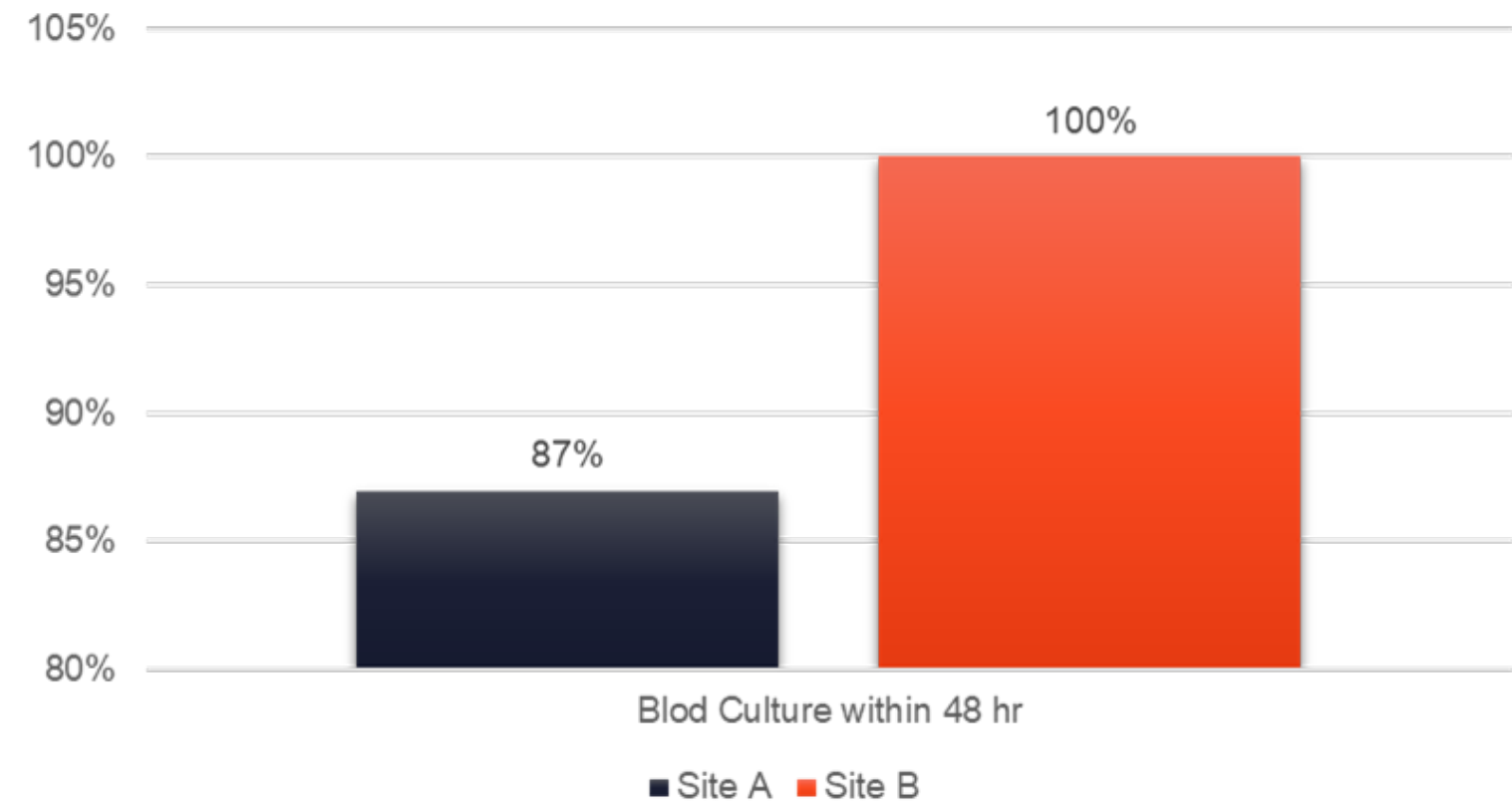Hypertension
Cancer
Chronic Kidney Disease
Liver Disease
Pulmonary Disease
Congestive Heart Failure
Lymphoma
Diabetes
Chronic Obstructive Pulmonary Disease
Myocardial Infarction
Neutropenia

Step 6: Pilot Results
Data Site A; 1-Qtr impact BCID, Raw
n = 538 bacteremia, n = 274 sepsis

Bacteremia, IP Mortality NSD, 30% improved
- PRE: 6.9%
- POST: 4.9%

Bacteremia, 1 mo. Mortality, NSD
- PRE: 8.7%
- POST: 10.7%

Bacteremia, 30d Readmission, NSD, 14% improved
- PRE: 14.7%
- POST: 12.6%

Sepsis IP Mortality, NSD, 37% improved
- PRE: 13.3%
- POST: 8.3%

Sepsis, 1 Mo Mortality, NSD
- PRE: 5.3%
- POST: 8.3%

Sepsis, 30d Readmission, NSD, 6% improved
- PRE: 8.8%
- POST: 8.3%
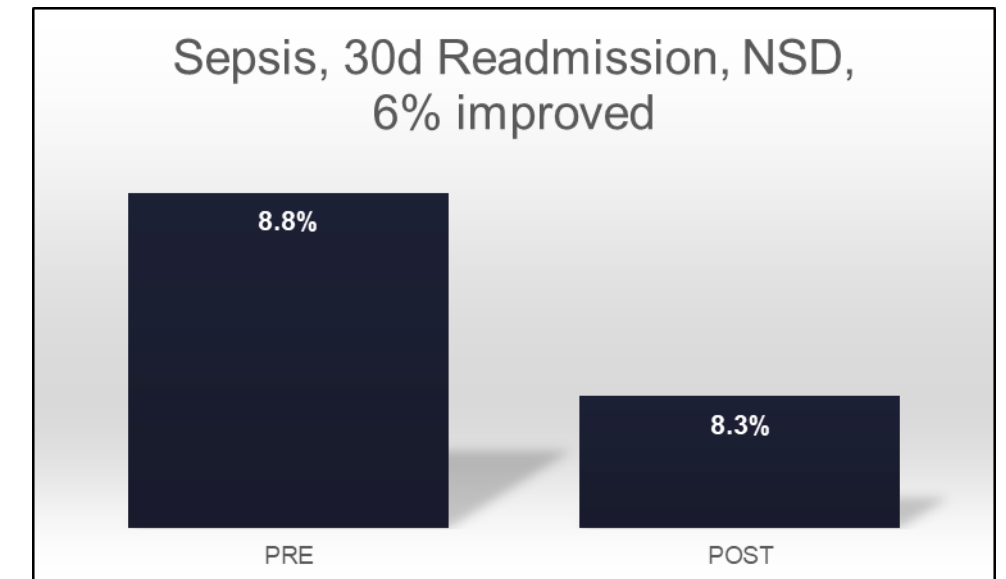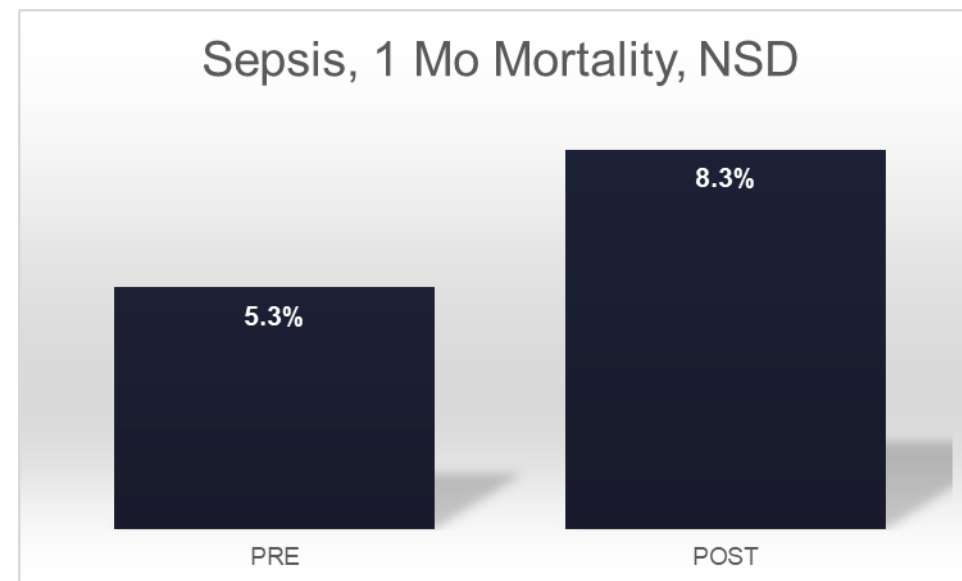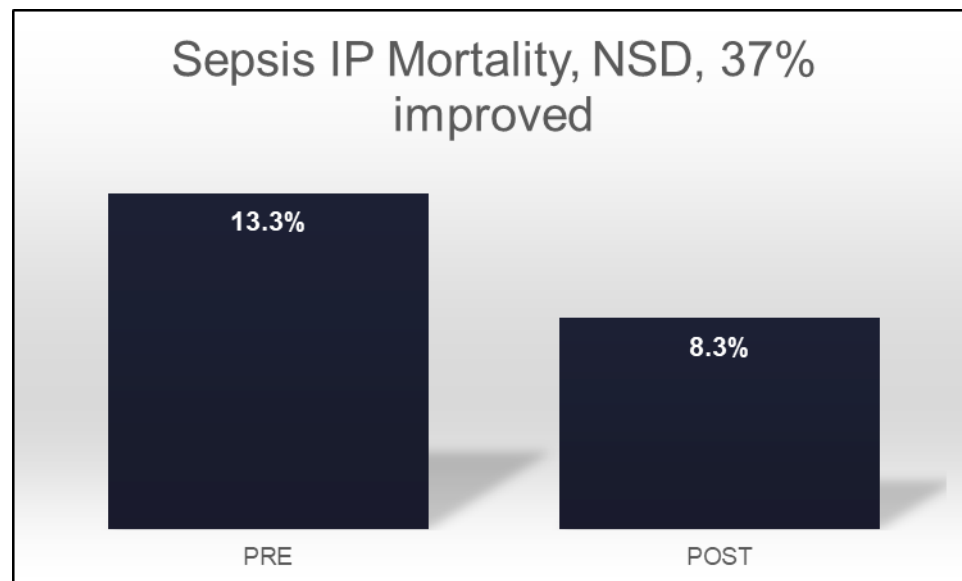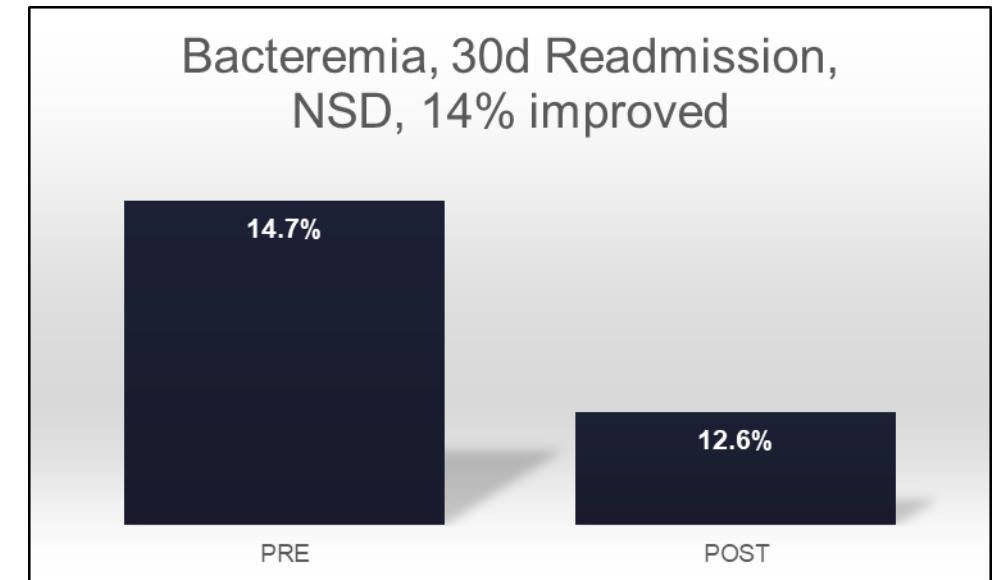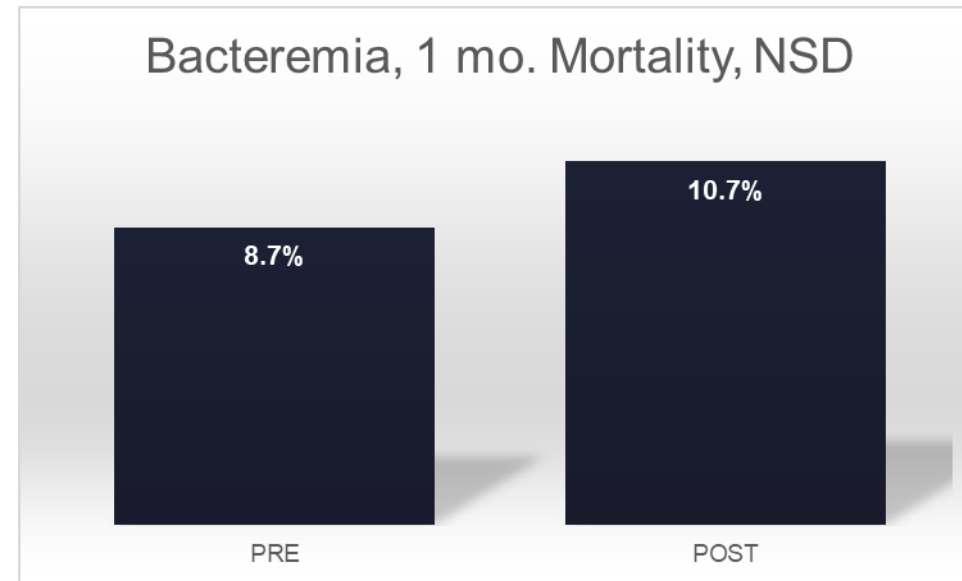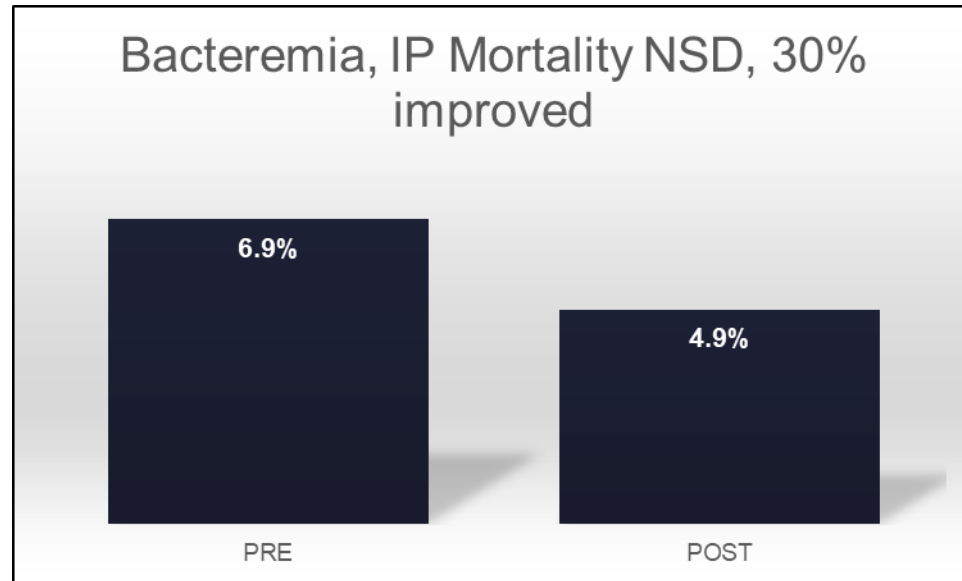
Step 5: Pilot Results
Data, Site B, impact BCID, Raw
n = 610 bacteremia, n = 1756 sepsis

Bacteremia, IP Mortality, NSD, slight increase

PRE 2.8% POST 4.0%

Bacteremia, 1 Mo. Mortality, NSD, slight increase

PRE 6.4% POST 7.6%

Bacteremia 30d Readmission, NSD, slight increase

PRE 34.6% POST 34.9%

Sepsis, IP Mortality, NSD

PRE 6.2% POST 6.5%

Sepsis, 1 month mortality, p= 0.05, improved 37%

PRE 9.6% POST 7.0%

Sepsis, 30d Readmission, p= 0.02, improved 17%

PRE 37.2% POST 31.7%
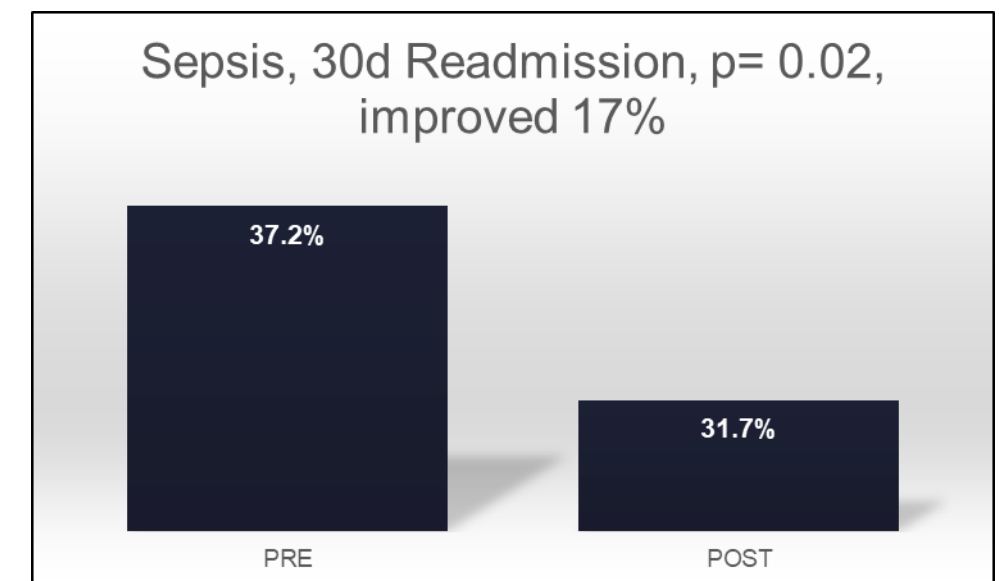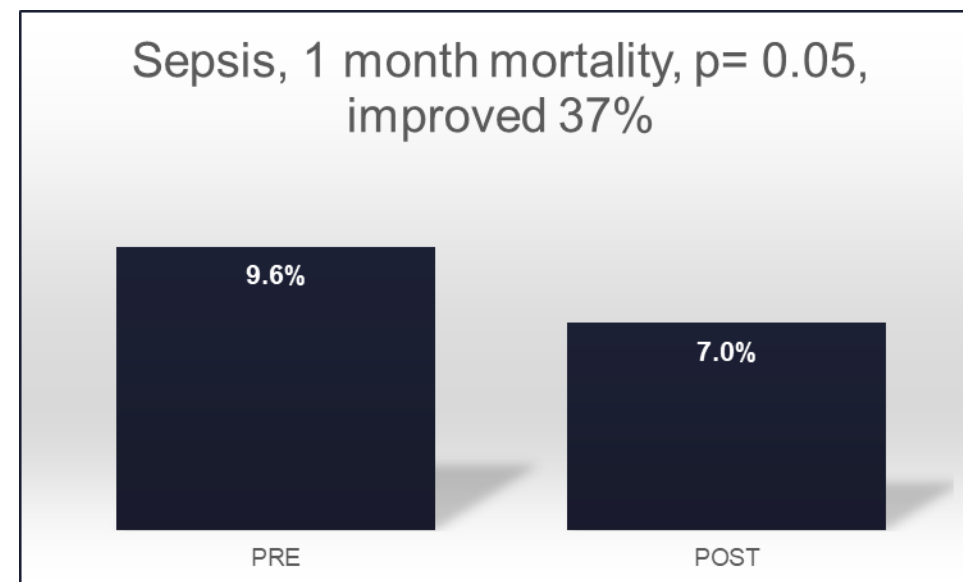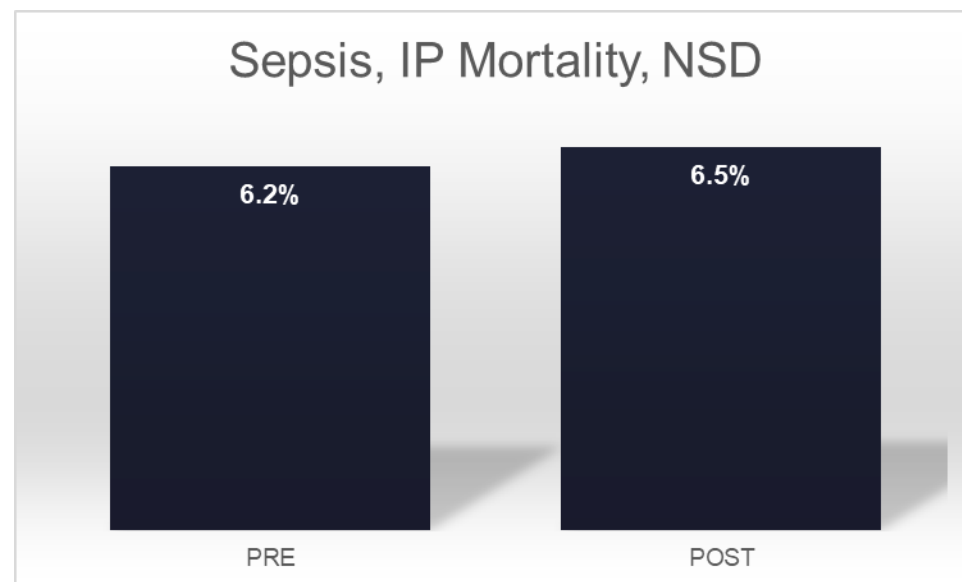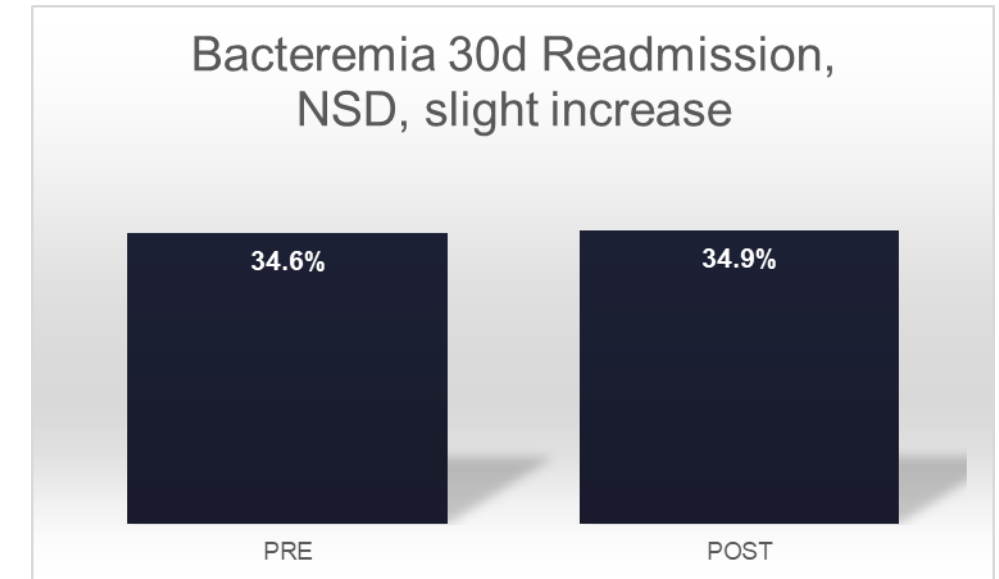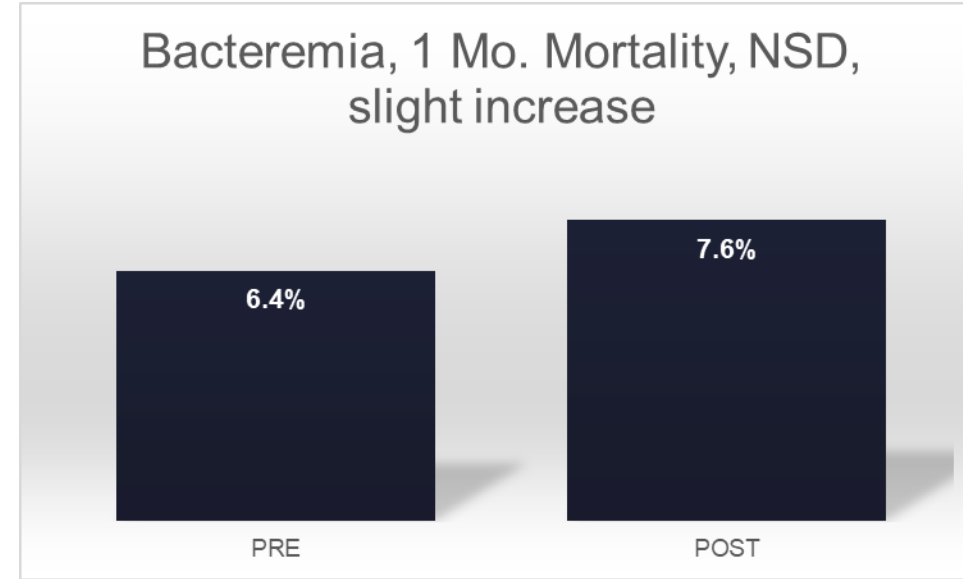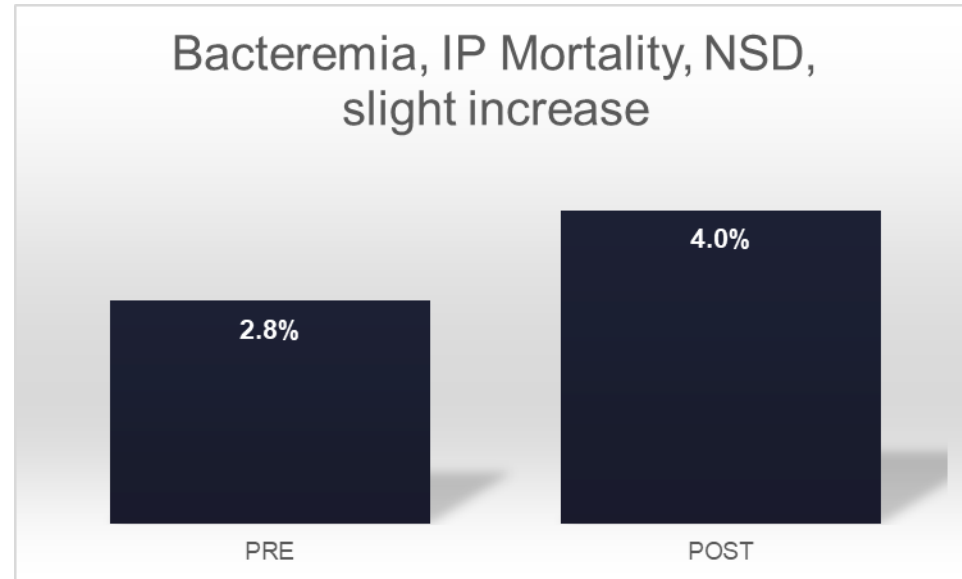
Step 7: Post-Mortem of Pilot

Learning Health Systems

Impact analysis: Clinical, Financial, Operational, Quality metrics

Post-mortem

Publication

Communication

Next Steps

Independently defines sepsis cohorts

Add Race and SDOH variables

Add Microbial Genus species

Use RXNorm Codes

Challenges - Why the Original and Recent Delay?

External Forces

- Funding
- Processes
- Competing priorities
- SARS-CoV-2 Pandemic
- Data Access

Lack of Standard Tools

- Data governance
- Data extraction
- Experimental processes
- Project mgmt. tools
- Bibliographic/Writing

Limited Experience/Infrastructure

- Laboratory Scientists / Data Scientists
- Workforce training for Multi-site trials
- Partnership-building with data scientists at EACH Site
- Data scientists require funding
- Biostatisticians need local data familiarity

Future considerations for multi-site projects
Value-based Care Teams

External Factors

Actions to counteract bottlenecks:

Refine funding processes and strategies to support future efforts and funding

Encourage external funding for sites outside the PSF process, whose insights can be shared with PSF constituents with data set sharing from funded projects (share knowledge outside of meetings)

AHRQ, PCORI etc.

We all want fast, accurate and cheap, but need data infrastructure/expertise

SDOH

Avoid DRG coding bias

Standardization

Actions to counteract data sharing

Common and Longer-term DUA

Determine location, common software

Provide training in data science and structuring QI projects

Recommend common experimental strategies to use together for all future teams (Biostatistician or Epidemiologist to partner with a Laboratory Medicine Subject Matter Expert, aka LMSE)

Common Software, Project Management, Document Software, Data Lake, Reference Library, and Learning Hub

FHIR/HL7/LOINC/SNOMED

Severity scores/cohorts

Infrastructure

Actions for redundancy

Per Site, Standard Composition of Teams

- Principle/Leads, MSE (Laboratory, Pharmacy, Financial, Insurance, Quality, Etc.) + Co-principle other sites, MSE
- Project Coordinator/Org. Historian
- Data Scientist/Coder/Abstractor
- Laboratorian with data analytics and curation training
- Basic biostatistics knowledge

Shared Expertise Roles

- Biostatistician(s) and/or Epidemiologist(s)
- Librarian
- Survey Expertise, as needed

Anemia Phase 1: Institutional Review Of aNemia (IRON): Understanding the Role of Anemia Cascades
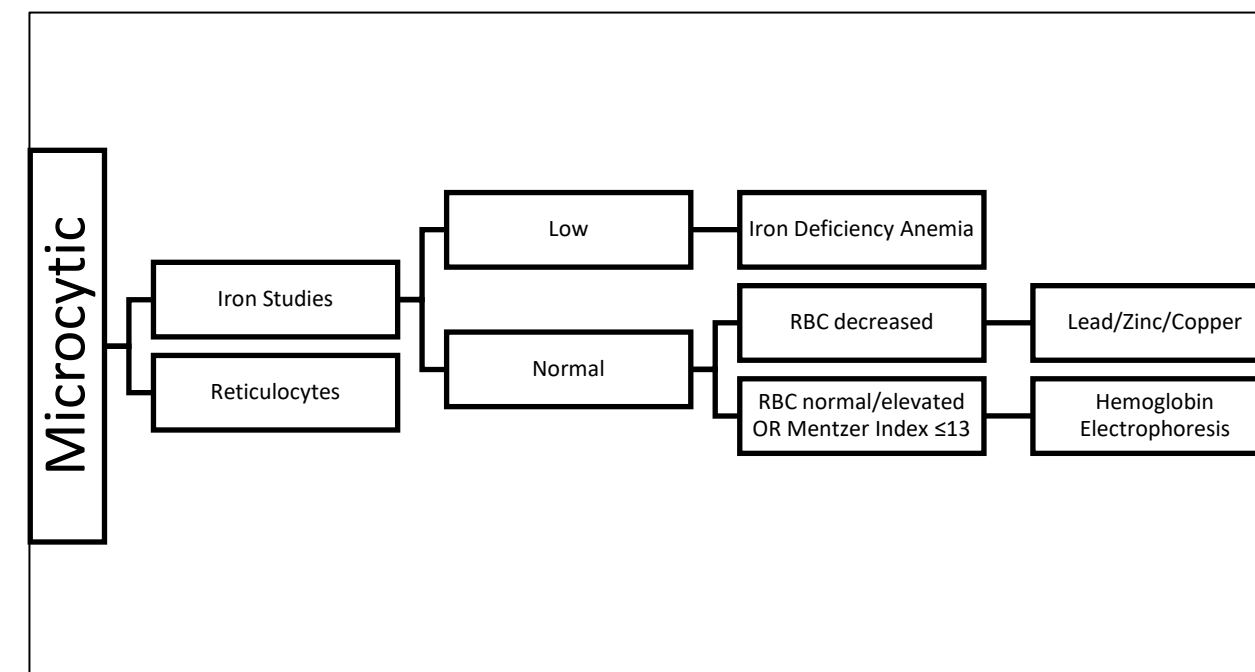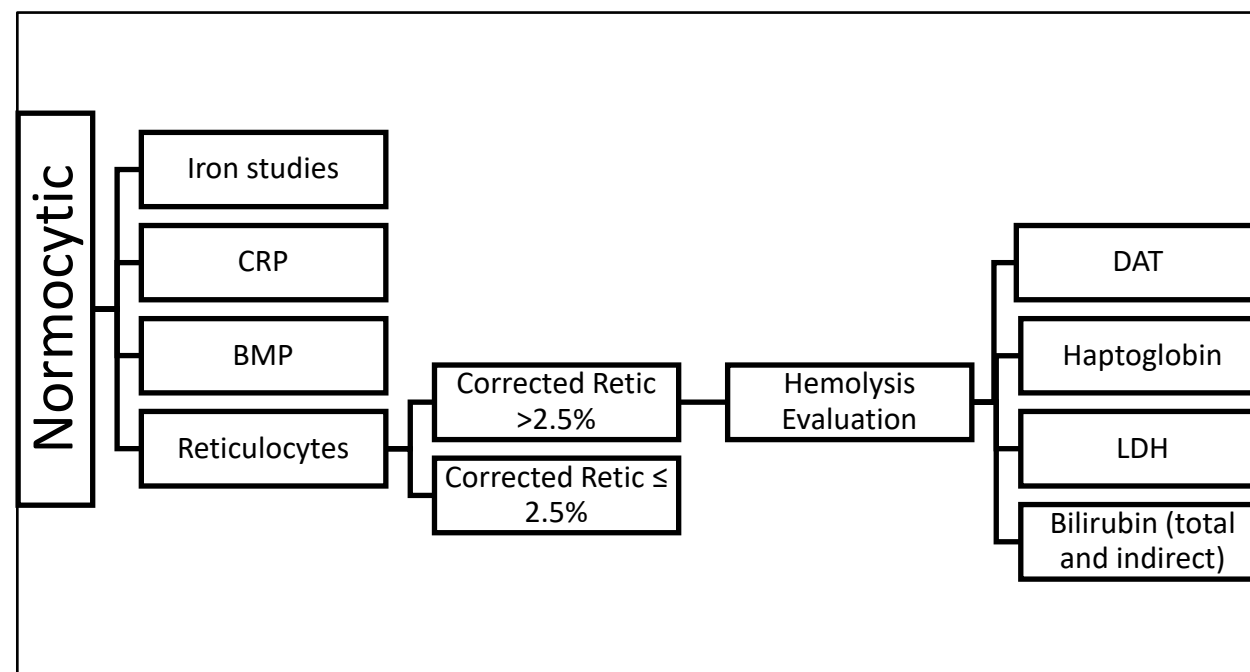
Study Objective:

Assess current ordering practices in the workup of anemia and identify opportunities for implementation of reflex testing.

Online Survey in collaboration with American Society for Clinical Pathology (ASCP) Center for Quality and Patient Safety

Anemia Phase 1: Institutional Review Of aNemia (IRON): Understanding the Role of Anemia Cascades

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Lab-Driven Care Model for Anemia

Process Improvements in Anemia Testing and Diagnosis using Cascades

to support Value Based Care:

A Guide for Clinical Laboratories

Normocytic
- Iron studies
- CRP
- BMP
- Reticulocytes
  - Corrected Retic >2.5%
  - Corrected Retic ≤ 2.5%
    - Hemolysis Evaluation
      - DAT
      - Haptoglobin
      - LDH
      - Bilirubin (total and indirect)

Microcytic
- Iron Studies
- Reticulocytes
  - Low
    - Iron Deficiency Anemia
  - Normal
    - RBC decreased
      - Lead/Zinc/Copper
    - RBC normal/elevated OR Mentzer Index ≤13
      - Hemoglobin Electrophoresis

Anemia Phase 2: Retrospective Evaluation of Anemia Conditions for Targeted Intervention (REACT) : Focus on longitudinal CBC data for actionable insights

Two phase Study:

Retrospective examination of longitudinal CBC data to improve screening for anemia

and

Create facilitated intervention as part of LIS workflow

Non-Alcoholic Fatty Liver Disease

Phase 1: Observational RWD: What is the current use of the screening test

Phase 2: Prospective study of real-world use

Phase 3: Prospective clinical trial of utility of the laboratory test

Clinical Lab 2.0 Recommendations for Laboratories wanting initiative

- ✓ **Start with a question/problem in mind**
- ✓ **DO connect with organizational leaders**
- ✓ **DO align the CL 2.0 strategy with organizational financial drivers and clinical priorities**
- ✓ **DO create an innovative internal team**
- ✓ **DO develop data analytics capabilities**

Swanson KS, Dodd M, VanNess, R, et al. *The Journal of Applied Laboratory Medicine*, Volume 3, Issue 3, 1 November 2018, Pages 487–497, https://doi.org/10.1373/jalm.2017.025379

Clinical Lab 2.0: Recommendations for Laboratories wanting initiative: Looking for patients at high risk
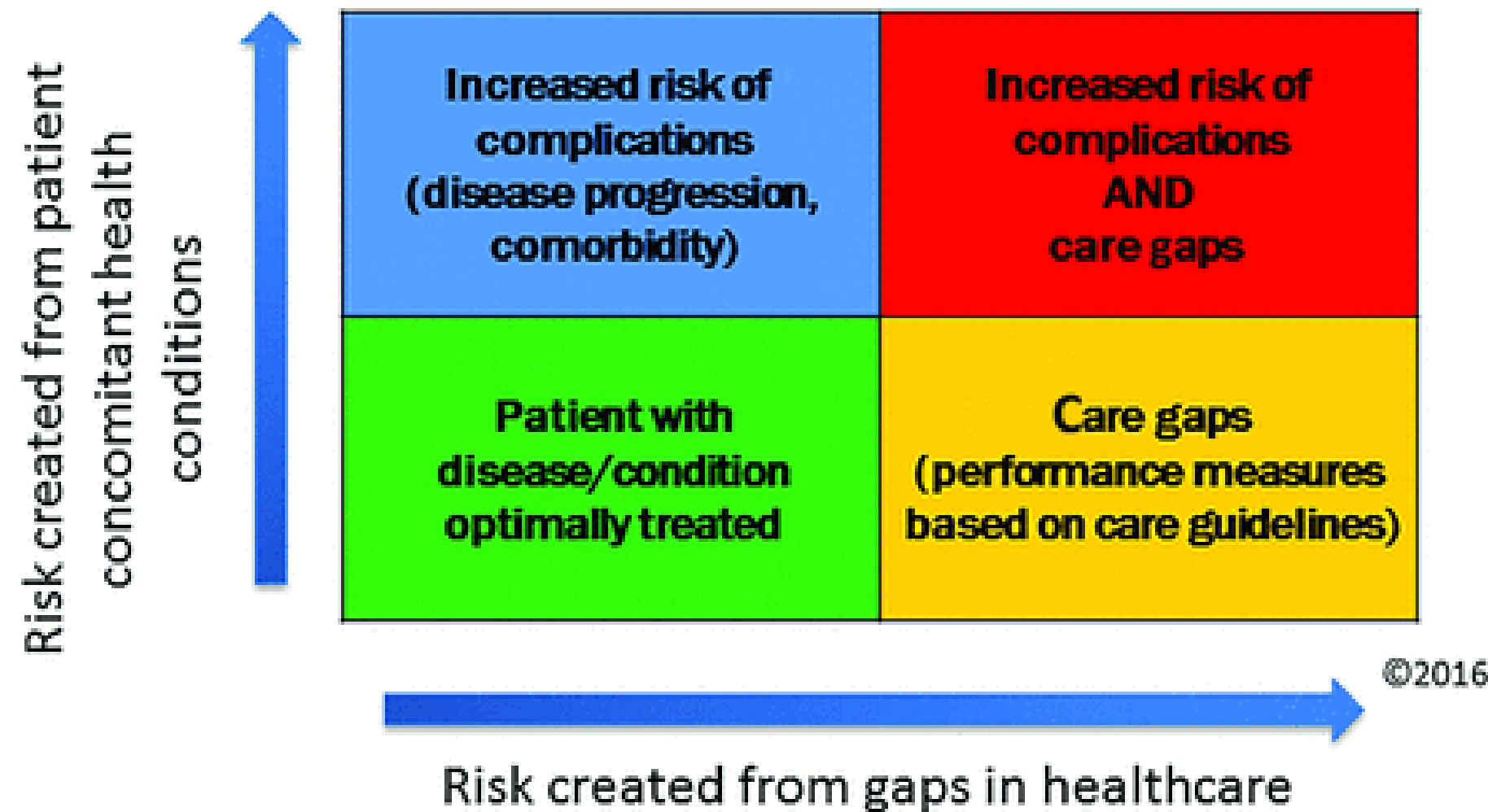
Risk stratification matrix to assist in prioritizing patients for population health initiatives

Clinical Lab 2.0 Recommendations for Laboratories wanting initiative

- ✓ **DO NOT create laboratory diagnostic insights that do not integrate into workflow**
- ✓ **DO NOT assume everyone will buy into your "GREAT IDEA"**
- ✓ **DO NOT assume you can do this with existing resources**

Swanson KS, Dodd M, VanNess, R, et al. *The Journal of Applied Laboratory Medicine*, Volume 3, Issue 3, 1 November 2018, Pages 487–497, https://doi.org/10.1373/jalm.2017.025379

Sustainable Lab Interventions

✓ **Based on scientific reasoning**

✓ **Designed with a process in mind**

✓ **Adaptable to specific to a population (ie. Disease state)**

✓ **Focus on appropriate resource utilization**

✓ **Improvements based on time**

CONVERGENCE

of Laboratory Diagnostics and Population Health

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