Why implementation science?

- The need to close the 17-year evidence to practice translational gap (aka the “Know-Do” gap) is broadly recognized.

- Using implementation science to expand use of proven cancer prevention and early detection strategies was one of 10 transformative research recommendations by the Cancer Moonshot℠ Blue Ribbon Panel.

- The International Agency for Research on Cancer (IARC) 2021-2025 Strategic Plan includes Implementation Research as one of three emerging research priorities (in collaboration with the WHO).

- How is implementation research different from general biomedical research?
Research goal in biomedical science
focus on health outcome
“Does the intervention work?”
Biomedical Innovation at NCI

Knowledge generation
Scientific research ranging from basic to population science identifies targets for development of drugs, devices, or vaccines to prevent or treat cancer.

INTERVENTION DESIGN: Drug, device, behavior change
RANDOMIZED CONTROLLED TRIALS
NEW EVIDENCE-BASED INTERVENTION

INTENDED IMPACT
Reduced burden of cancer
Research goal in implementation science
Focus on implementation outcome
“What works, for whom, in what circumstances, and why?”
- Pawson and Tilley 1997
UNDERSTANDING THE GAP

RCTs have shown that INTERVENTION “X” increases survival from, treats, or prevents DISEASE “Y”

- INTERVENTION “X under, over, or misappropriately used
- Insufficient training/infrastructure/governance/policy environment to deliver INTERVENTION “X”

Implementation agents

Continued high burden of DISEASE “Y” despite efficacious interventions
RCTs have shown that INTERVENTION “X” increases survival from, treats, or prevents DISEASE “Y”

- INTERVENTION “X” under, over, or misappropriately used
- Insufficient training/infrastructure/governance/policy environment to deliver INTERVENTION “X”

UNDERSTAND implementation process barrier framed on implementation outcomes

DESIGN strategies to overcome the individual or organizational barriers

TEST and ADAPT strategies to new contexts

DECREASED burden of DISEASE “Y” due to effective context adaptation of implementation process
To summarize…

- "Implementation science is the study of methods to promote the adoption and integration of evidence-based practices, interventions, and policies into routine health care and public health settings to improve our impact on population health."

- Implementation science views context and complexity as research targets
  - This contrasts with traditional biomedical research (e.g., randomized controlled trials, or RCTs) which view context and complexity as confounders to be controlled.

- Real-world effectiveness of evidence-based interventions requires understanding the interactions involved in implementing complex interventions into complex health systems in a variety of sociopolitical, socioeconomic, and cultural contexts.
A topical example: COVID-19

The Context and Implementation of Complex Interventions (CICI) Framework

SARS-CoV-2 vaccines

Masking

Implementation theory

Implementation strategy

Implementation agents

Implementation process

Implementation outcomes

Setting

Other independent interventions

Context

Socio-economic

Socio-cultural

Epidemiological

Geographical

Ethical

Legal

Political

Public health agencies
Employers
Schools
Health systems
Pharmacies
Government
Community groups
Individuals
Etc...

Vaccine and mask mandates
Restrictions
Incentives
Peer advocacy
Etc.

Public health agencies
Employers
Schools
Health systems
Government
Community groups
Individuals
Etc...

CENTER FOR GLOBAL HEALTH

STRATEGIC PLAN 2021-2025

GOAL 1: SUPPORTING INNOVATIVE, IMPACTFUL GLOBAL CANCER RESEARCH

Accelerate global cancer implementation science.

https://www.cancer.gov/about-nci/organization/cgh/about/strategic-plan
Global implementation science through a systems lens

- Many of our implementation strategies are designed to react to observed events.
- CGH seeks to support research that looks deeper to understand the patterns, underlying structures and mental models which result in similar events across a variety of contexts.
Paradigm shift from traditional linear to complex systems

- Requires re-thinking research paradigms
- Move from purely reductionist methods to systems science

Table 1  Comparison of traditional and complex system analytic assumptions

<table>
<thead>
<tr>
<th>Domain</th>
<th>Traditional analytic techniques assumptions</th>
<th>Complex systems assumptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functional form</td>
<td>Linearity</td>
<td>Nonlinearity</td>
</tr>
<tr>
<td>Common distributions</td>
<td>Normality</td>
<td>Nonnormality</td>
</tr>
<tr>
<td>Characteristics of actors</td>
<td>Homogeneity</td>
<td>Heterogeneity</td>
</tr>
<tr>
<td>Level of analysis</td>
<td>Single level</td>
<td>Multiple levels</td>
</tr>
<tr>
<td>Temporality</td>
<td>Static or discretely longitudinal</td>
<td>Dynamic, with feedback</td>
</tr>
<tr>
<td>Fundamental relationships</td>
<td>Among variables</td>
<td>Interaction of actors</td>
</tr>
<tr>
<td>Perspective</td>
<td>Reductionist</td>
<td>Holistic</td>
</tr>
</tbody>
</table>
Complex systems: More than a sum of their parts

Complex Systems

- Made up of a large number of *heterogeneous elements*
- That *interact* with each other
- Producing an emergent *effect* that is different from the effects of the individual elements
- Which *persists* over time and *adapts* to changing circumstances

With permission from Douglas Luke, Washington University in St. Louis
Study designs

- Hypothesis generation (non-experimental)
  - Mixed methods (integrated quantitative and qualitative designs)
- Hypothesis testing (pragmatic, quasi-experimental)
  - Pre-post design, or ‘natural experiments’
  - Stepped wedge designs
  - Interrupted time series
- Evidence synthesis
  - Realist evaluation
  - Computational modeling and systems science (system dynamics, network analysis, agent-based modeling)
Trends in systems approaches in cancer research

Pubmed "systems thinking" OR "complex adaptive systems" OR "systems science"

YEAR

number of publications


ALL

cancer
Global inequities in application of systems thinking in implementation research

Figure 2 World map of the 1,386 MEDLINE records mentioning the terms “systems thinking”, “complex adaptive systems”, or “systems science”. Source: GoPubMed, which reports the frequency that terms appear in MEDLINE indexes for publications, which include titles, abstracts, journal names and corresponding author’s affiliation. This data was obtained on 14 August 2014.
What do we gain from global implementation science?

Re-thinking evidence synthesis to increase equity in cancer prevention and control
Implementation Science in LMICs – the research gap

- Systematic review* (n=10,292)
  - Description of Intervention (n=791)
  - Contextual Factors (n=415)
  - Adaptations (n=101)
  - Implementation Components (n=28)
  - Implementation Outcomes (n=14)

Alonge et al 2019 *BMJ Global Health*
Reducing inequities in cancer control through global IS
Modernizing our concepts of generalizability

Realist evaluations result in context-specific ‘theories of action’, or generalizable ‘rules of thumb’ for implementation

Reducing inequities in cancer control through global IS
QUESTIONS?