PAEDIATRICS, ADOLESCENT MEDICINE AND TRAFFIC MEDICINE

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Children's Hospital of Philadelphia™

Perelman School of Medicine
University of Pennsylvania

Royal College of Physicians of Ireland

3 April 2019

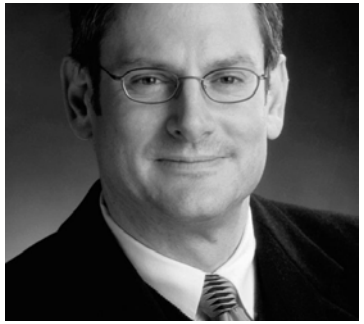
LONG WAY FROM MY DISSERTATION
BUT STILL AN ENGINEER AT HEART

1989

The Modulation of Intracellular Free Calcium Concentration by Biaxial Extensional Strains of Bovine Pulmonary Artery Endothelial Cells

Flaura Koplin Winston

A DISSERTATION
in
Bioengineering



2019

Lesson:
Follow your passion
Value your strengths

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FINANCIAL DISCLOSURES

- I am the Chief Scientific Advisor and co-Founder of the CHOP spin-out, Diagnostic Driving, Inc.
- My work has been funded by a variety of sources: NIH, NSF, PA Department of Transportation, PA Department of Health, State Farm Insurance Companies, and a consortium of industry/government/non-profit sponsors.

"ACADEMIC DISCLOSURES"
TRUTH ABOUT SUCCESS

- **I cannot take sole credit** for anything.
  - I worked with many people - thank you!
- I had **many failures** along the way to success.
  - Failures shaped me and I embrace them.
- **I did not pursue one path** for career.
  - Goal: Research → Action → Impact

I'll approve it, but
why would someone study accidents?
– Chair of CHOP IRB ~1993

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CENTER FOR INJURY RESEARCH & PREVENTION PLAYED **MAJOR** ROLE IN SUCCESS

Dedicated to advancing the safety of children, youth and young adults through research and action.

Learn more: **injury.research.chop.edu**

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GRATITUDE:
STANDING ON THE SHOULDERS OF GIANTS

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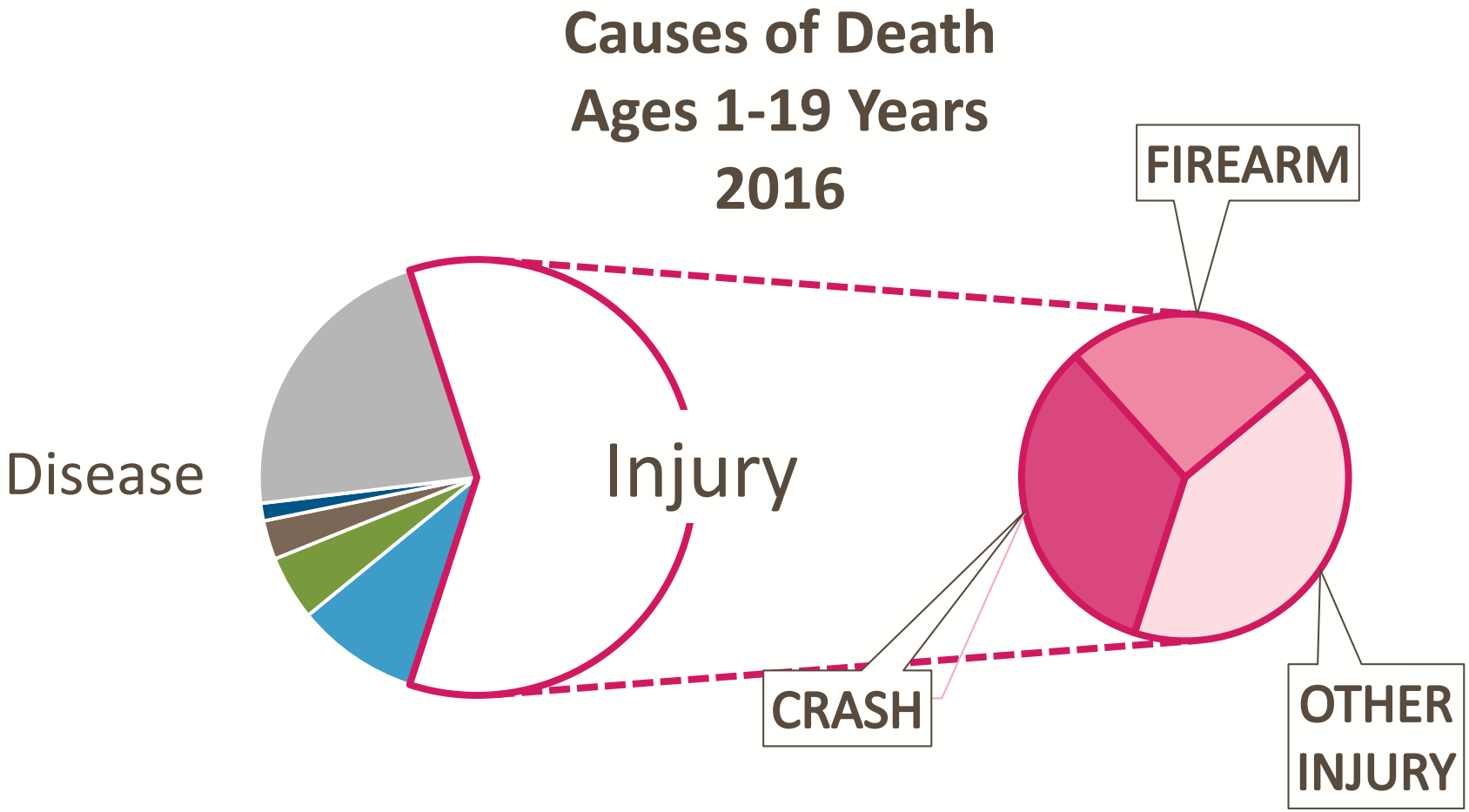
LEARNING OBJECTIVES

Upon completion of this session, participants will be able to:

- Define primary, secondary and tertiary prevention objectives for Traffic Medicine.
- Define period of highest lifetime crash risk and important reasons behind these crashes.
- Define “innovation” and gain familiarity with the concept of the “Valley of Death” for innovation and how it can become a “Challenge Basin”.

PROBLEM:
YOUTH ARE DYING PREVENTABLE DEATHS



Cunningham RM et al. N Engl J Med 2018;379:2468-2475

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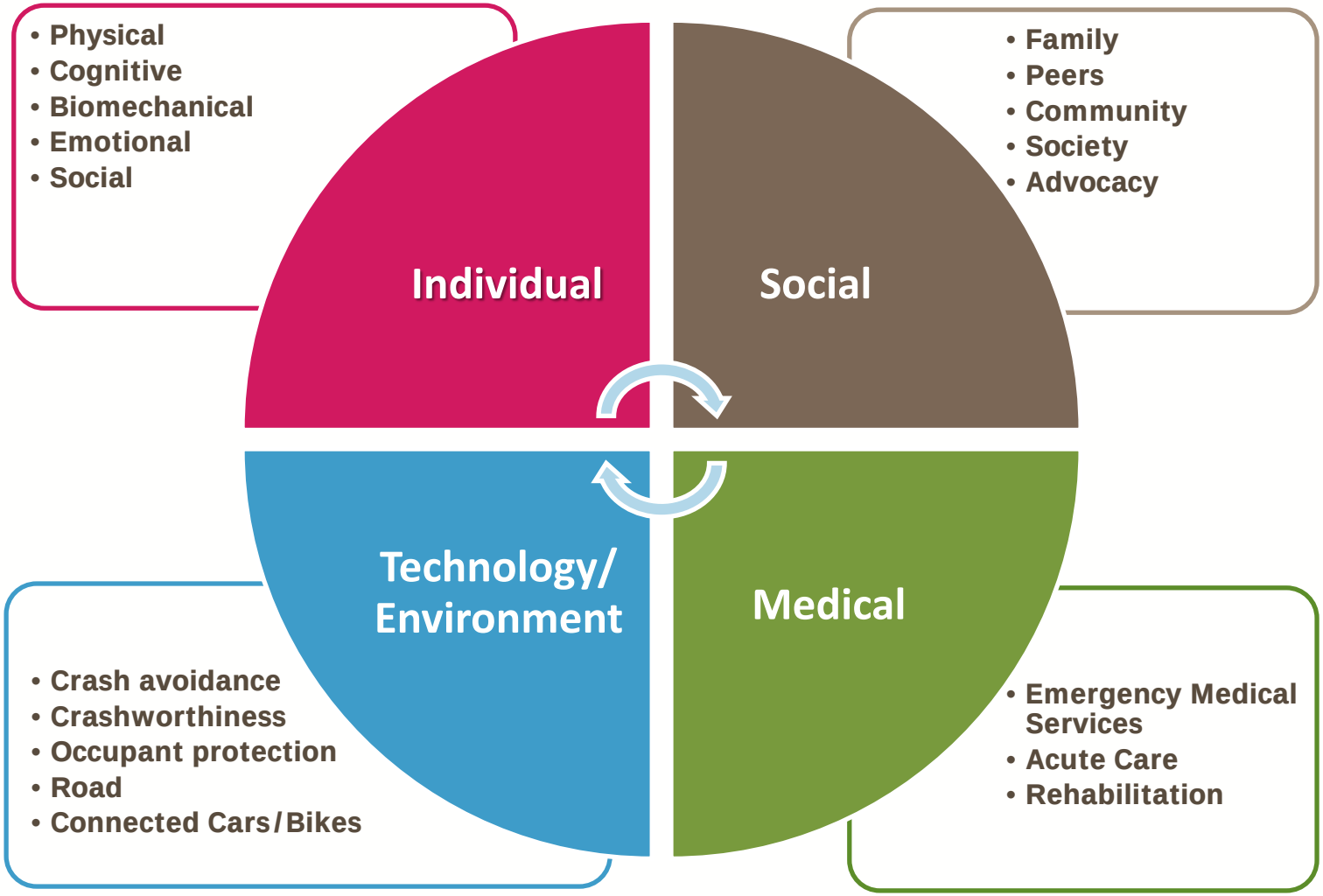
CHILD & ADOLESCENT SAFETY: COMPLEX



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PROBLEM STATEMENT:

Injury is the leading cause of child death yet the scientific foundation is insufficient. My work aims to reduce the burden of injury through research and action.

3 AIMS OF TRAFFIC MEDICINE:
PRIMARY, SECONDARY, TERTIARY PREVENTION

1. Prevent the **crash**

2. Given a crash, prevent crash **injury**

3. Given a crash injury, **resuscitate, rehabilitate, & optimize recovery**

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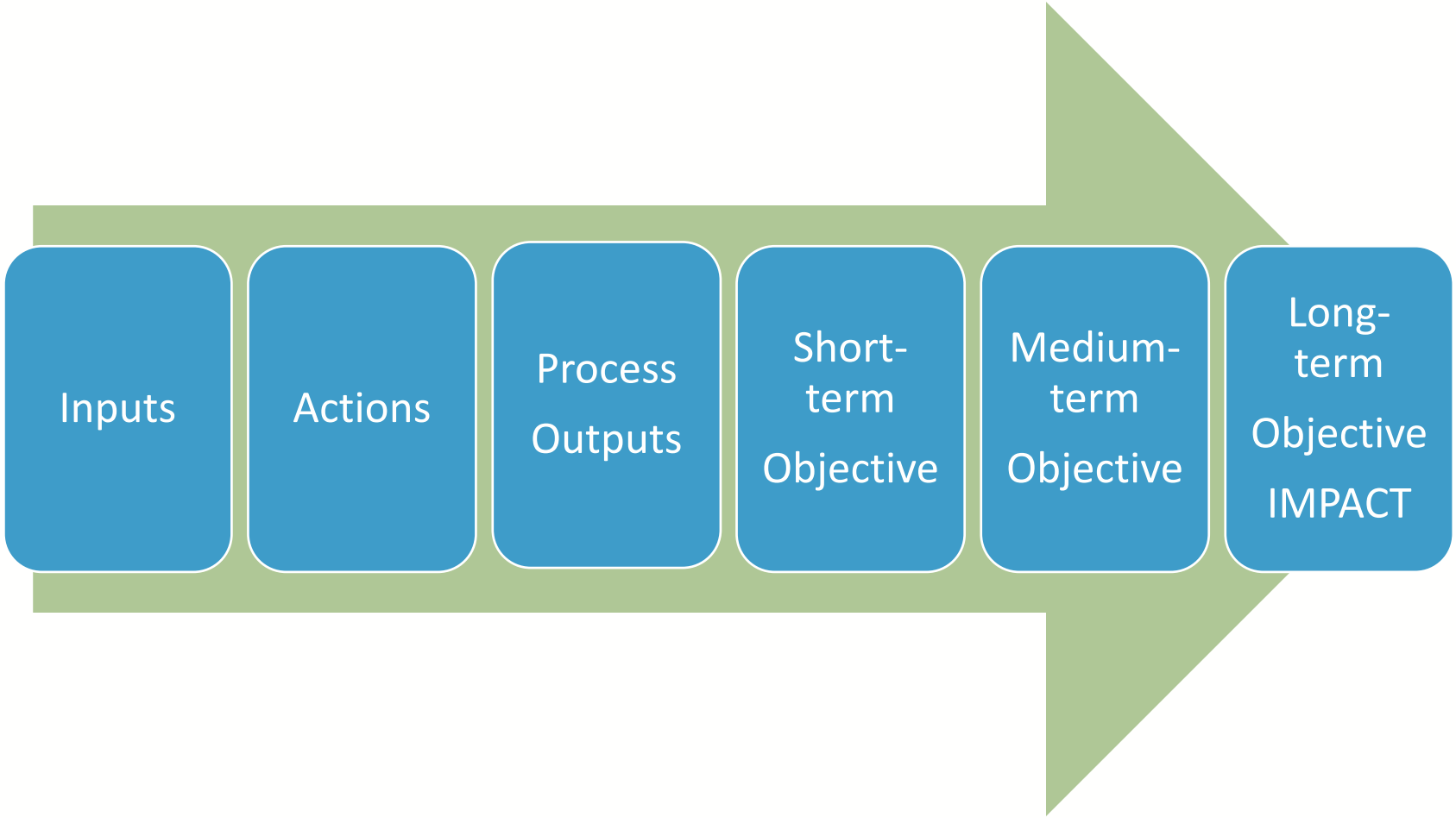
OVERARCHING STRATEGY:
FOCUS ON **IMPACT**



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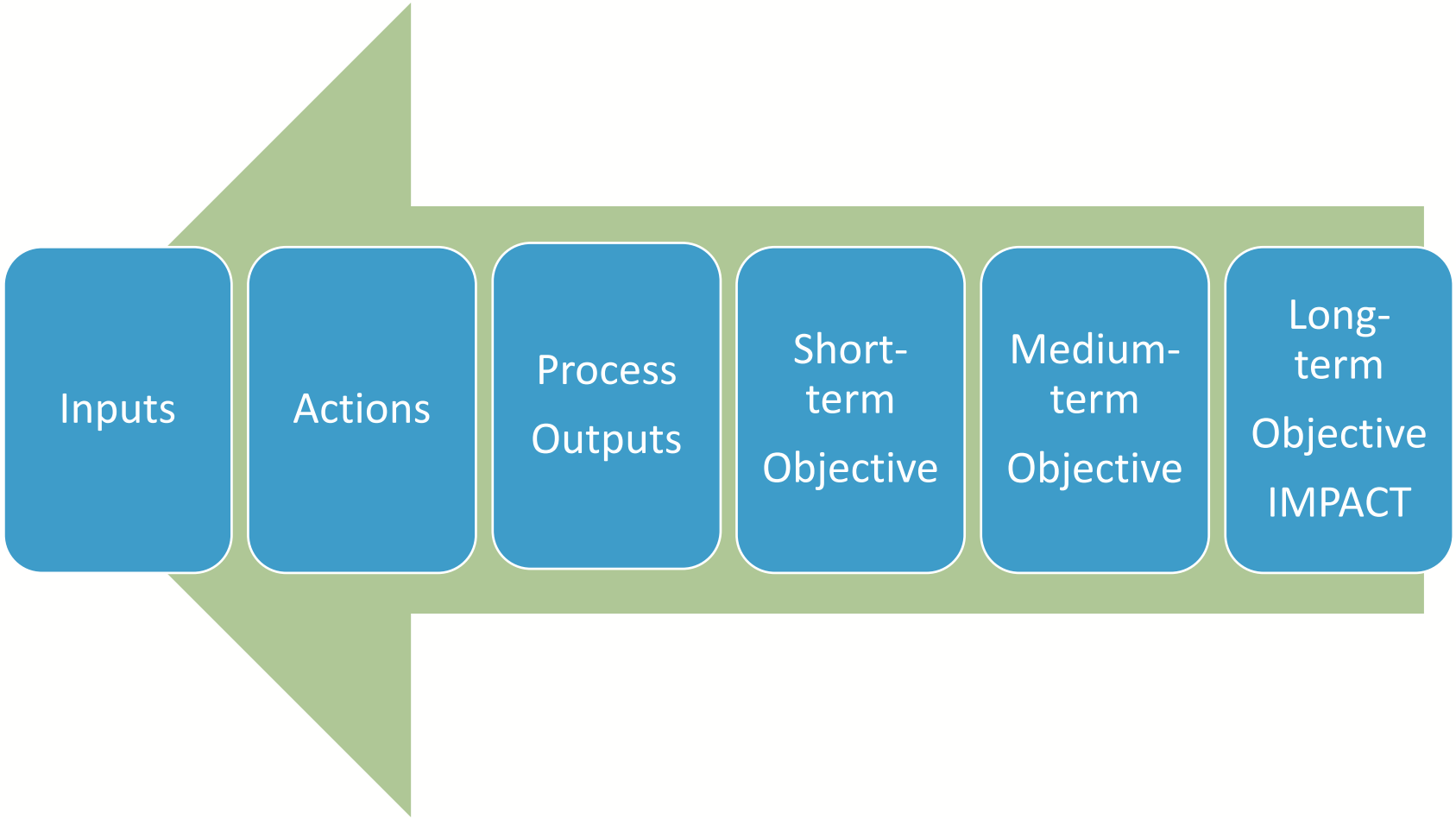
OVERARCHING STRATEGY:
PLAN BACKWARDS



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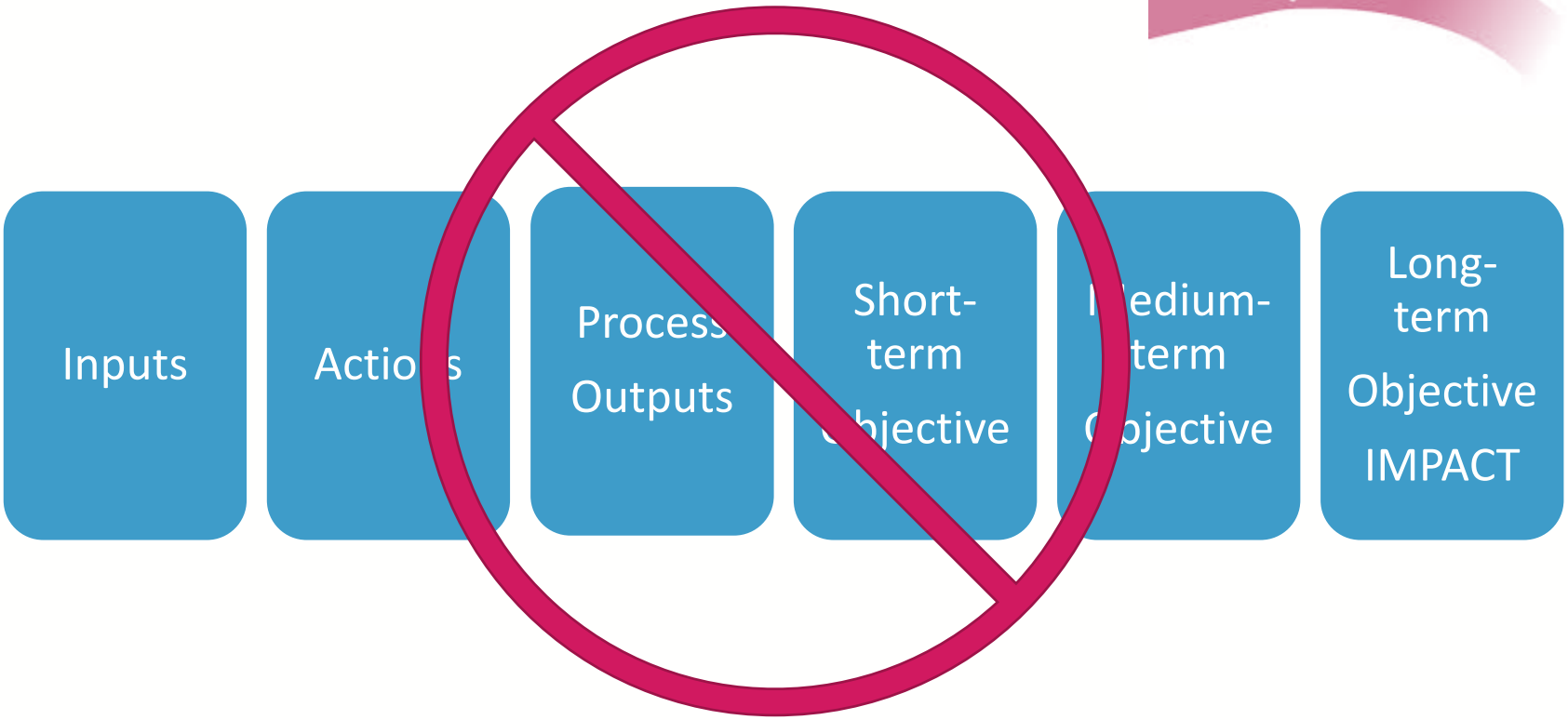
OVERARCHING STRATEGY:
MEASURE & LEARN
DECIDE: CONTINUE, PIVOT OR END



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APPROACH: RESEARCH
A CYCLE RATHER THAN A STRAIGHT PATH

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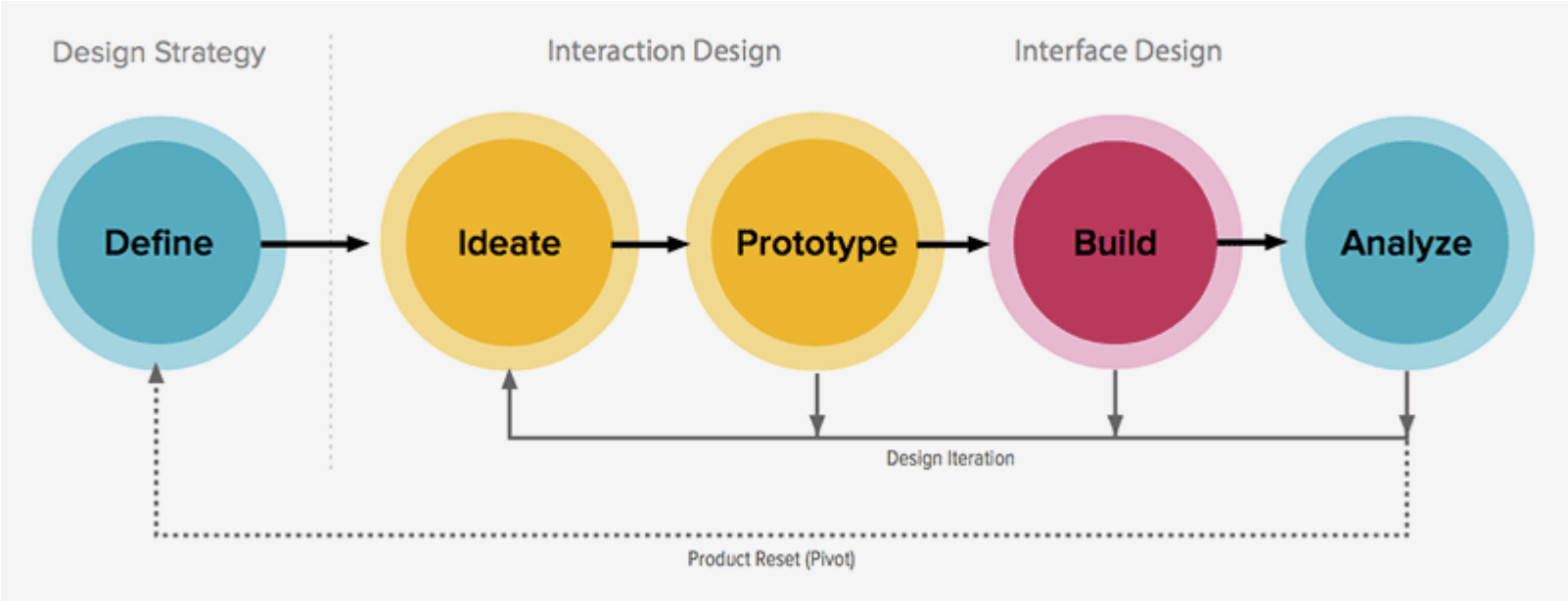
APPROACH: SOLUTIONS
SMALLER DESIGN CYCLES



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FIRST FOCUS: CRASH INJURY

1. Prevent the **crash**

2. Given a crash,
   prevent crash **injury**

3. Given a crash injury,
   resuscitate, rehabilitate, &
   optimize recovery

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CHILD DEATH FROM AIRBAGS
SENTINEL CASE: JULY 1995

Infant fatality

- 20-day old in rear-facing infant seat
- Survivable crash
  - Rear-facing child safety seats – highly effective
  - Collision at 23 mph
  - Driver survived

Take-away:
Investigate when
mechanism and expected outcome
do not match
clinical presentation.

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CRISIS: NO SCIENTIFIC FOUNDATION
NEED: CHILD-FOCUSED CRASH SURVEILLANCE
(WITH DURBIN, ARBOGAST AND OTHERS)


DEADLY AIR BAGS
How a government prescription for safety became a threat to children

COVER STORY

Why air bags are killing children

- Created child-focused crash surveillance system
  - Partner: large insurer
  - Case finding & consent
- 10 years, 750,000 children in crashes
  - Telephone interviews
  - Crash investigations

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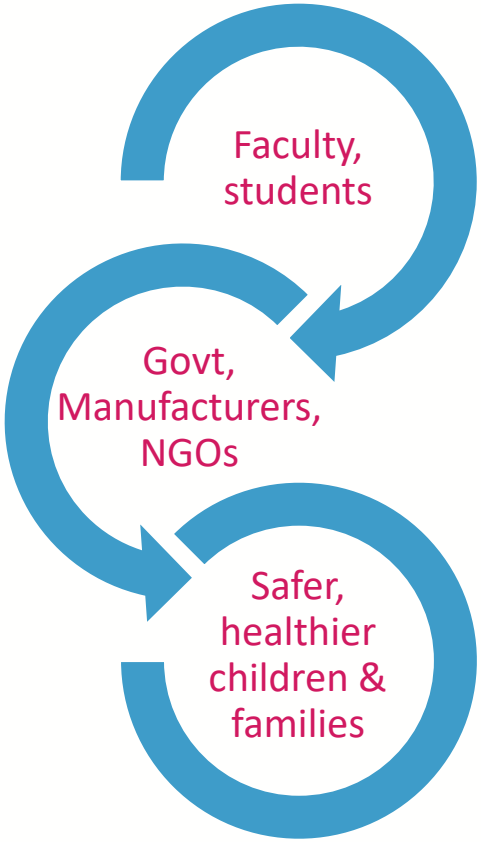
MORE PARTNERSHIPS TO ADVANCE SAFETY
NSF INDUSTRY/UNIVERSITY CENTER (CCHIPS)



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Penn University of Pennsylvania

The Ohio State University

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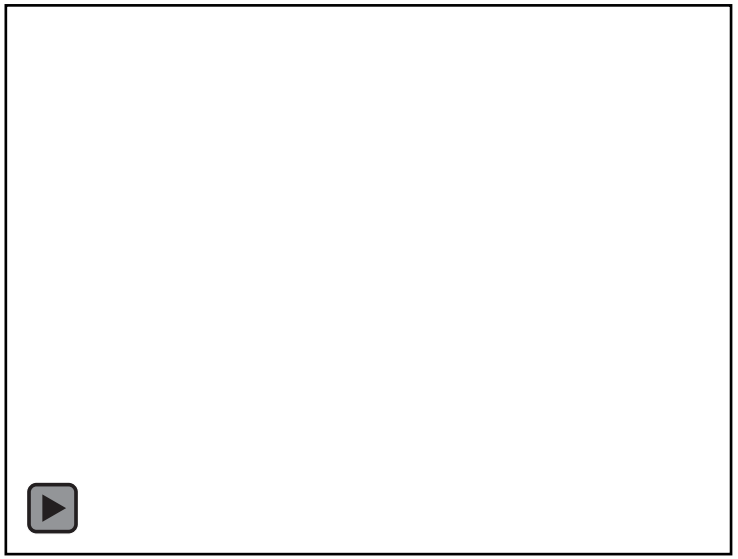
QUANTIFIED RISKS, EVALUATED TECHNOLOGY

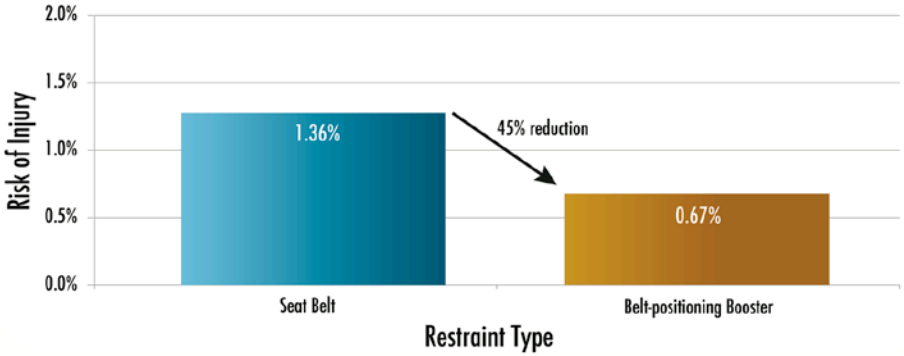


Air bags

Arbogast et al. JAMA Peds 159(4): 342-6, 2005

Booster seats

Durbin et al. JAMA 289(21): 2835-40, 2003.



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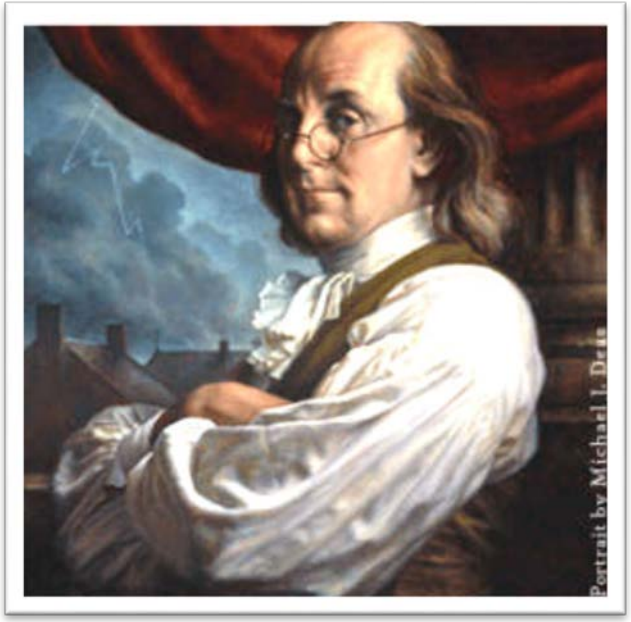
KEY FINDINGS

- Safety technology designed for adults can kill children.
- Children were not in correct restraint for age/weight.
- But.. prioritize safety messages. (Misused > NOT used)
  1. Restrain on every trip, every time.
  2. Use correct restraint for age and weight.
  3. Seat in the rear.
  4. Use restraints correctly.
- Safety messages evolve with science/tech advances.
  - Newer air bags are less dangerous.
  - RF to age 2; FF past age 4; Booster past age 8



ADVICE FROM BEN:

"Never confuse motion with action."

Publication was the
start, not the end
of action.

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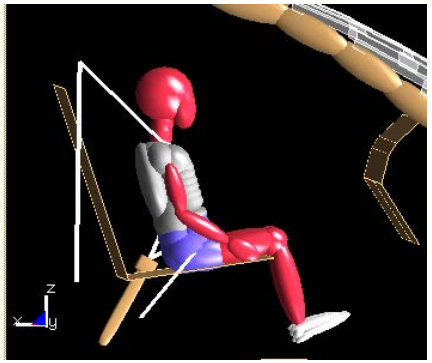
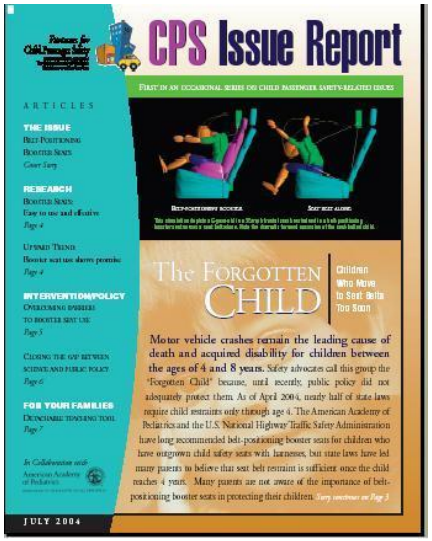
ACTION

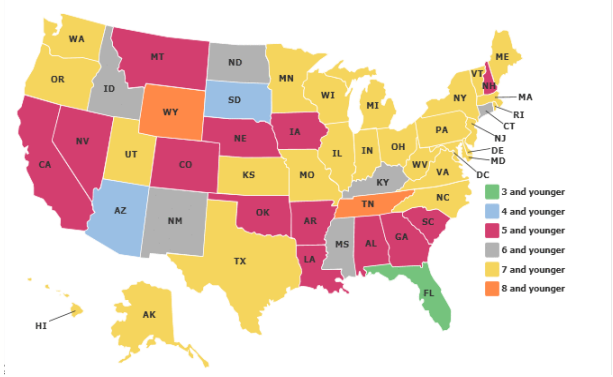
Informed Safety Products & Regulations



Created Educational Resources



Advocated for Evidence-based Laws



Provided Recommendations

American Academy of Pediatrics
DEDICATED TO THE HEALTH OF ALL CHILDREN™

NHTSA
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

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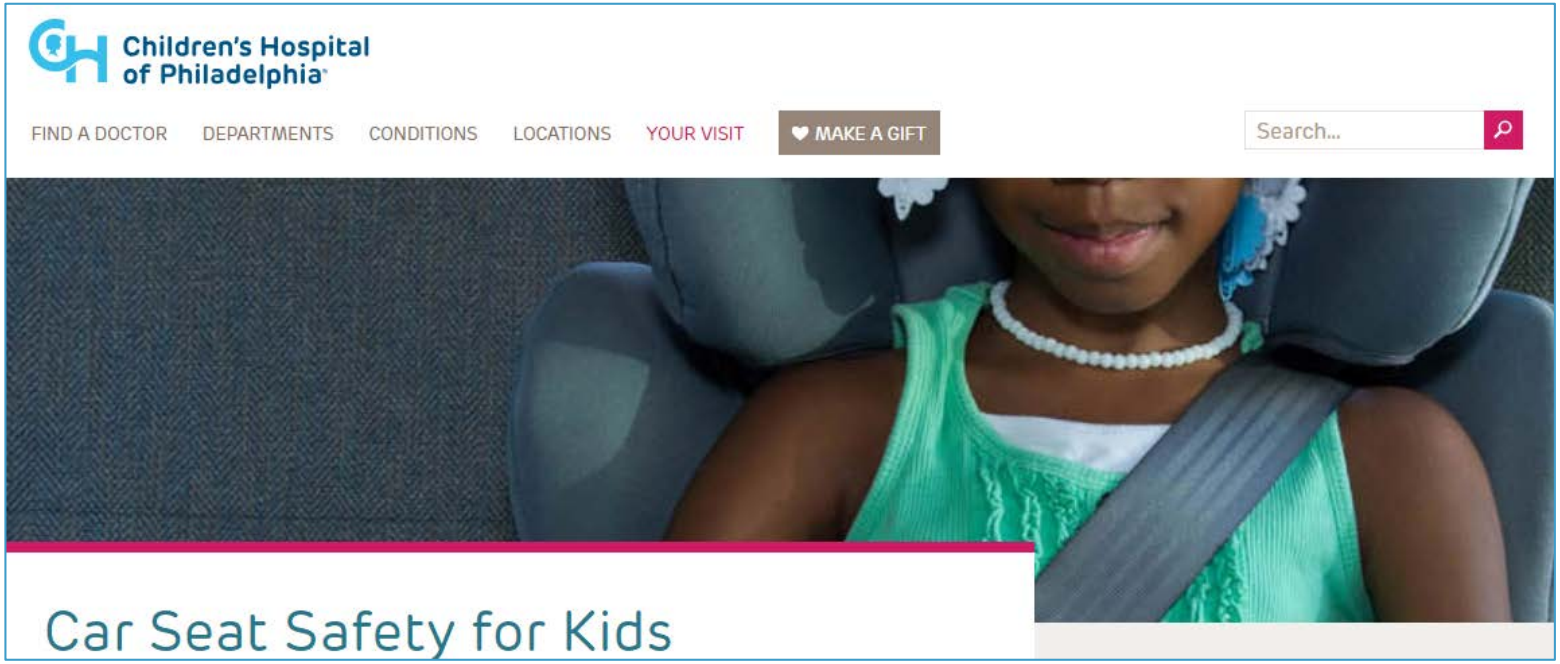
RESOURCE



chop.edu/centers-programs/car-seat-safety-kids

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IMPACT:
OUR RESEARCH INFORMED

- 2 fed laws, 48 state laws, products, regulations, programs
- >10,000 lives saved since 1997

American Academy of Pediatrics

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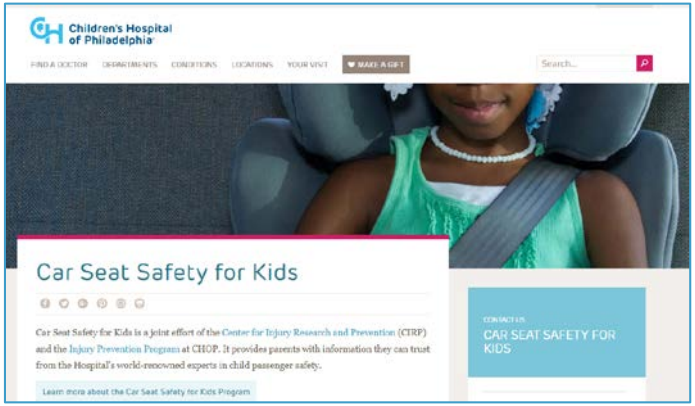
Organizational Principles to Guide and Define the Child Health Care System and/or Improve the Health of all Children

Policy Statement—Child Passenger Safety



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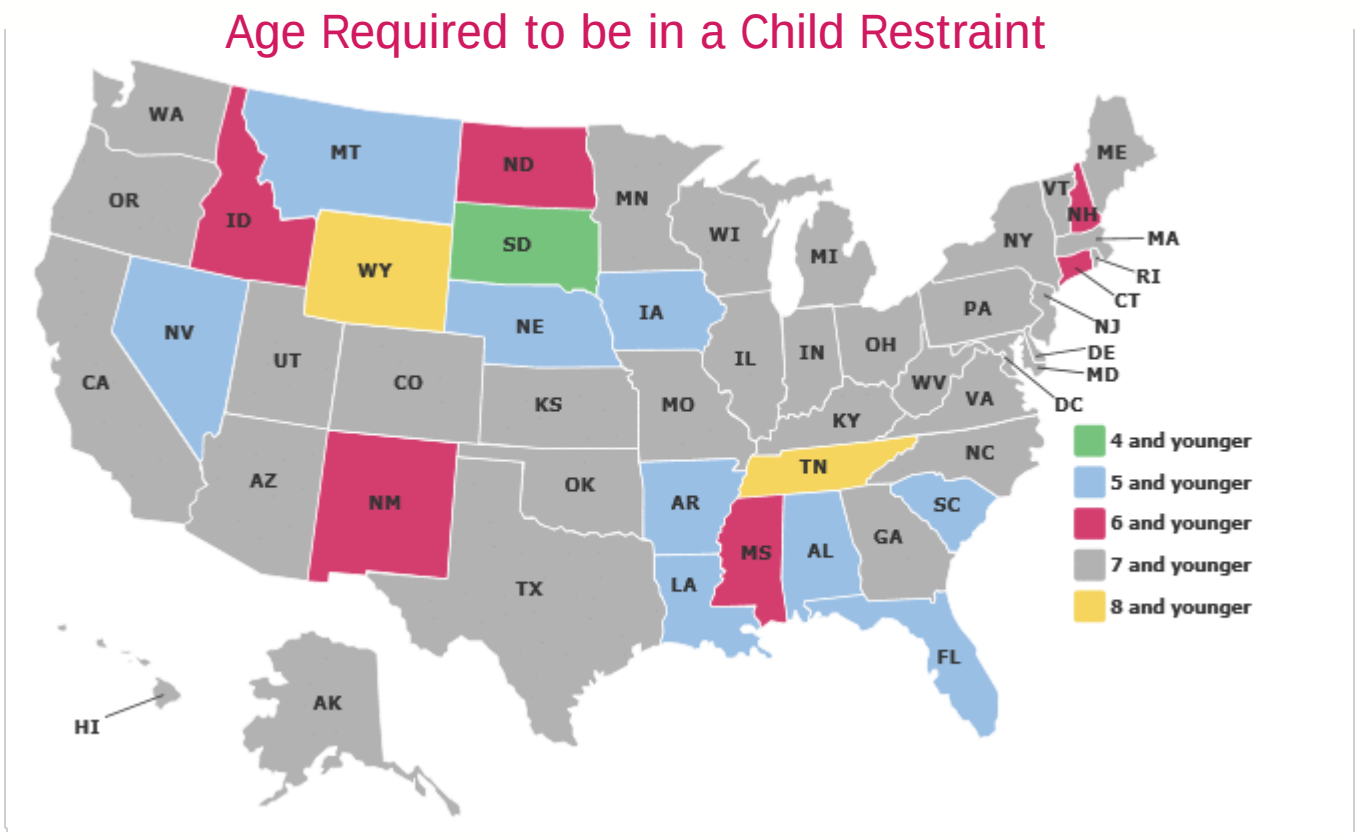
IMPACT:
UPGRADED LAWS



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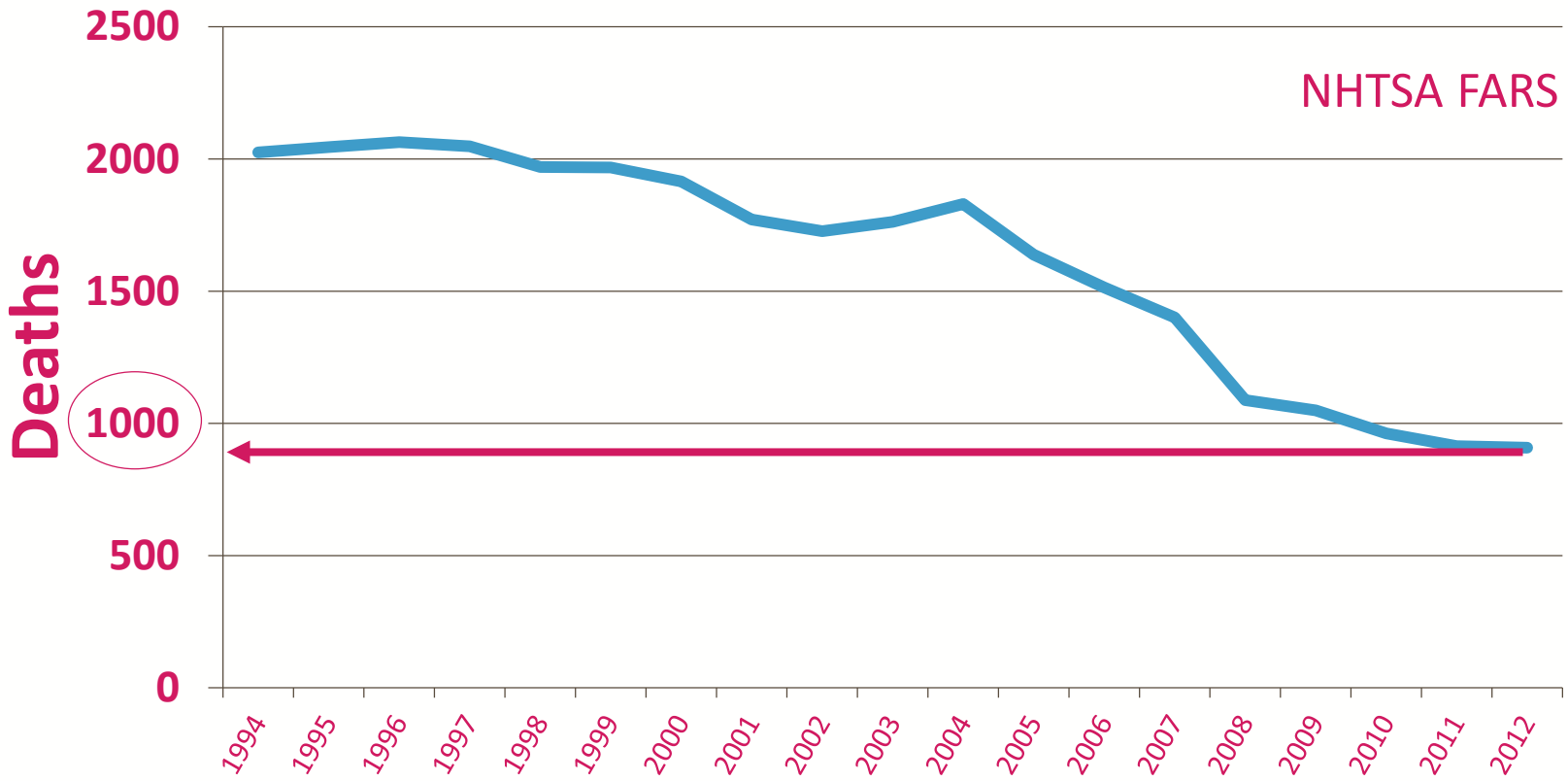
IMPACT: CRASH FATALITY

>50% REDUCTION IN DEATHS TO CHILDREN < 16



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WHAT WE LEARNED

- Partnerships may be essential.
  - Insurance Claims (field data collection)
  - Public Relations (influence/reach)
- There are limits to what we can do as academics.
  - Stakeholders improve products. (vehicles, CRS).
  - Stakeholders pass laws and regulations.
- Be aware of the unexpected.
  - Sometimes our hypotheses are wrong.
  - Early air bags killed children.
- Strong data are not enough.
  - Prepare messaging and tools for stakeholders.

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FEWER DEATHS, BUT STILL SERIOUS INJURY

For every **1** child that dies there are...

25 hospitalizations

925 treated in ER

Many more treated in doctors' offices

In 2005, injuries that resulted in death, hospitalization or an ER visit cost nearly $11.5 billion in medical expenses.

SOURCES: Web-based Injury Statistics Query and Reporting System (WISQARS), CDC, 2009.

National Health Interview Survey, 2009 data release, CDC, National Center for Health Statistics.

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PIVOT: ADDED SECOND FOCUS – RECOVERY
(WITH KASSAM-ADAMS, MARSAC, AND OTHERS)

1. Prevent the **crash**

2. Given a crash,
   prevent crash **injury**

3. Given a crash injury,
   resuscitate, rehabilitate, & optimize recovery

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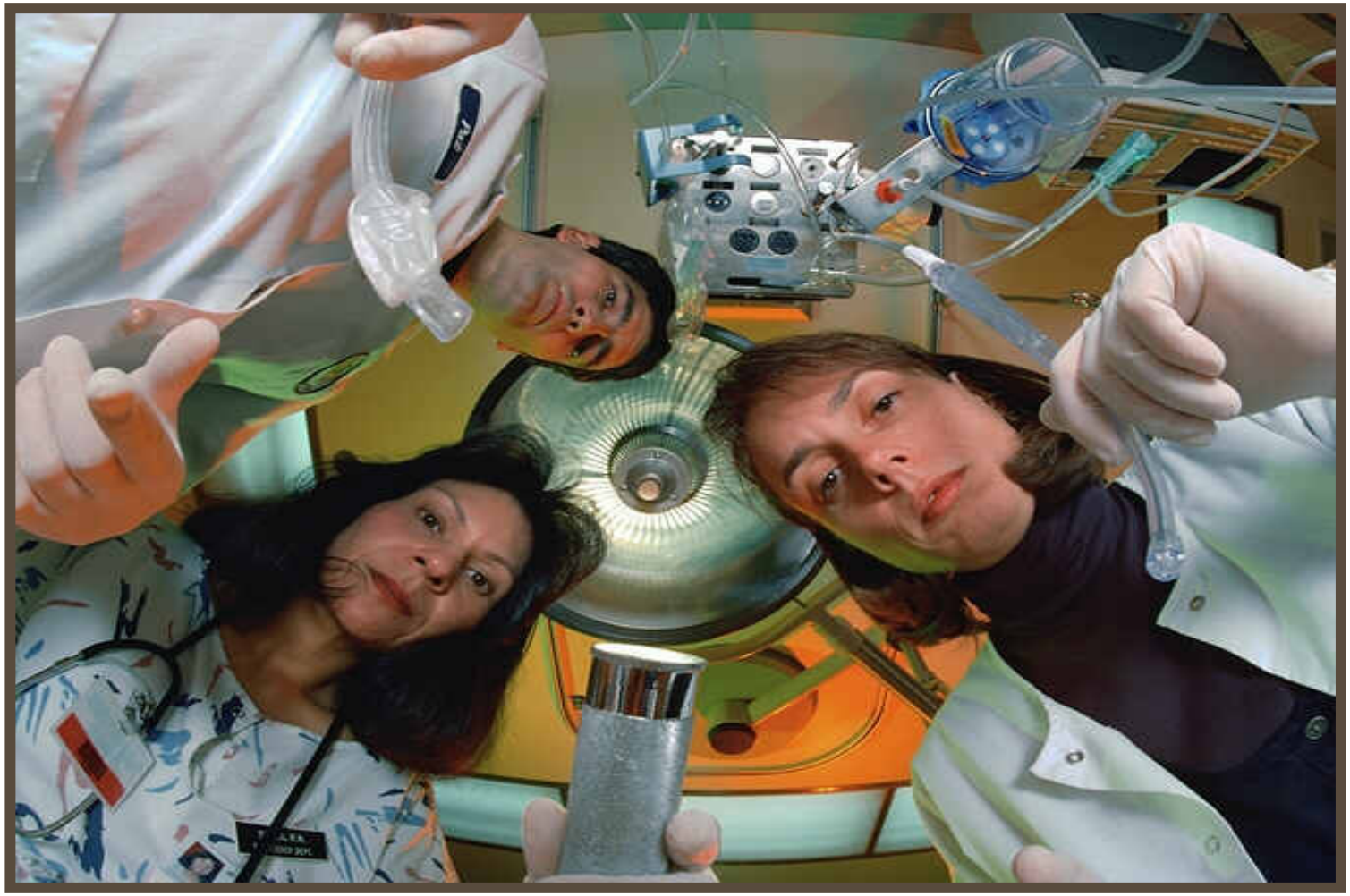
INJURY AND TRAUMATIC STRESS



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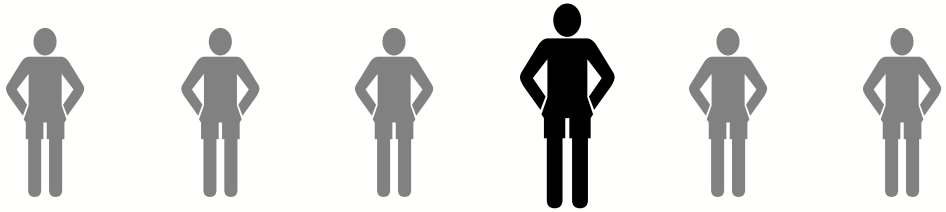
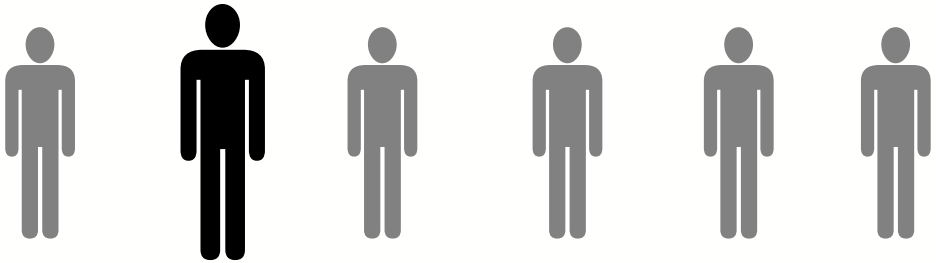
6 MONTHS AFTER CHILD INJURY

15%: TRAUMATIC STRESS REACTIONS & IMPAIRMENT

1 in 6 injured children



1 in 6 parents



Winston, Kassam-Adams, et al. JAMA 290(5) 2003.

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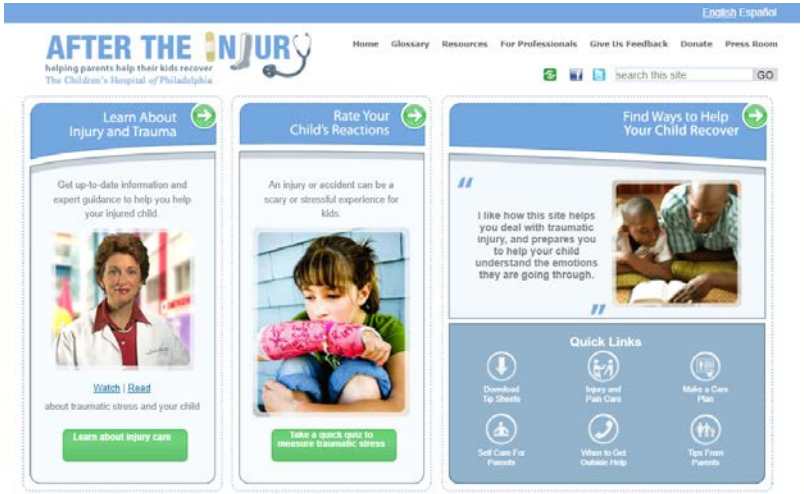
KEY FINDINGS

- Need to look beyond the physical injury.
  - Injury severity did not predict traumatic stress reactions.
  - Reactions related to perception of life threat.
- Need to support parents.
  - Parents: primary support for children during recovery.
  - Child reactions tied to parent reactions.
- Parents inaccurate in reporting child symptoms.
  - Need child self-report to get accurate reporting.

ACTION: ENHANCED CARE OF INJURED CHILD

Developed & implemented screening, interventions



RESOURCES

FOR PARENTS: **AFTERTHEINJURY.ORG**

FOR PROVIDERS: **HEALTHCARETOOLBOX.ORG**

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COPING COACH

- RCT
- 72 children
  - 36 CC/36 control
  - Feasible to deliver
  - Engaging for kids
  - ↓ traumatic stress

(Kassam-Adams et al., 2016)

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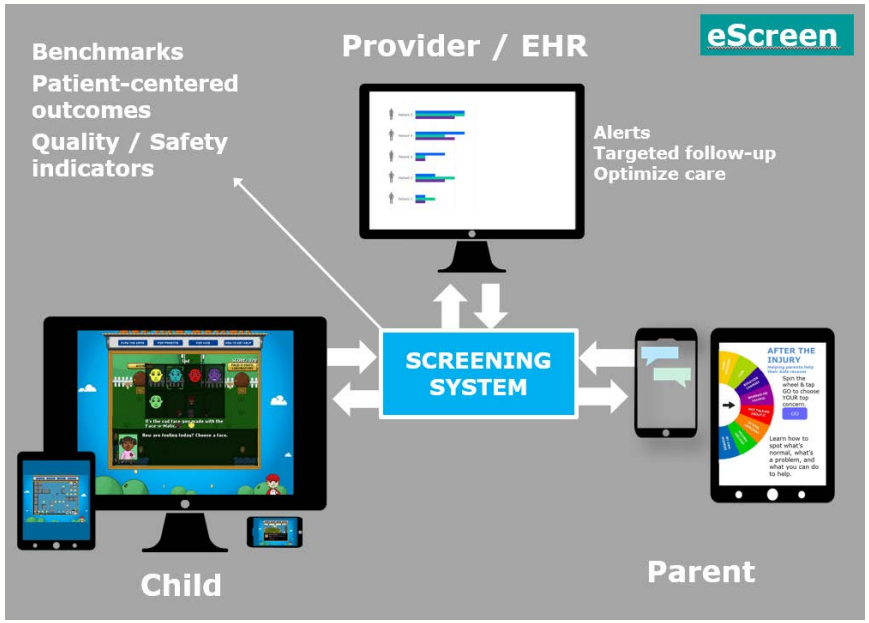
STTR-E-SCREEN

- eScreen
  - Partnered with Radiant Creative, LLC
  - Awarded STTR
  - Evolving Coping Coach to become a “sticky” child-reported symptom screening collection system



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IMPACT: OUR RESEARCH INFORMED

- Trauma-informed care for injured youth
  - Even those with minor physical injuries need support.
- Recognition of psychosocial needs in recovery
  - Both injured child **&** their parents need support.

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WHAT WE LEARNED:
STAKEHOLDERS NEEDED, DESPITE HOME INSTITUTION

- Clinical care change is disruptive.
  - For adoption, need internal stakeholders, tools and processes.
- Research and clinical/operations can be siloed.
  - Adoption after evidence is difficult.
- Always think about the end-game.
  - How will the research be implemented and sustained?
- Continue to measure and learn.
  - Initial screener results did not replicate well.
  - Refined screener/tools and continue to develop better tools.

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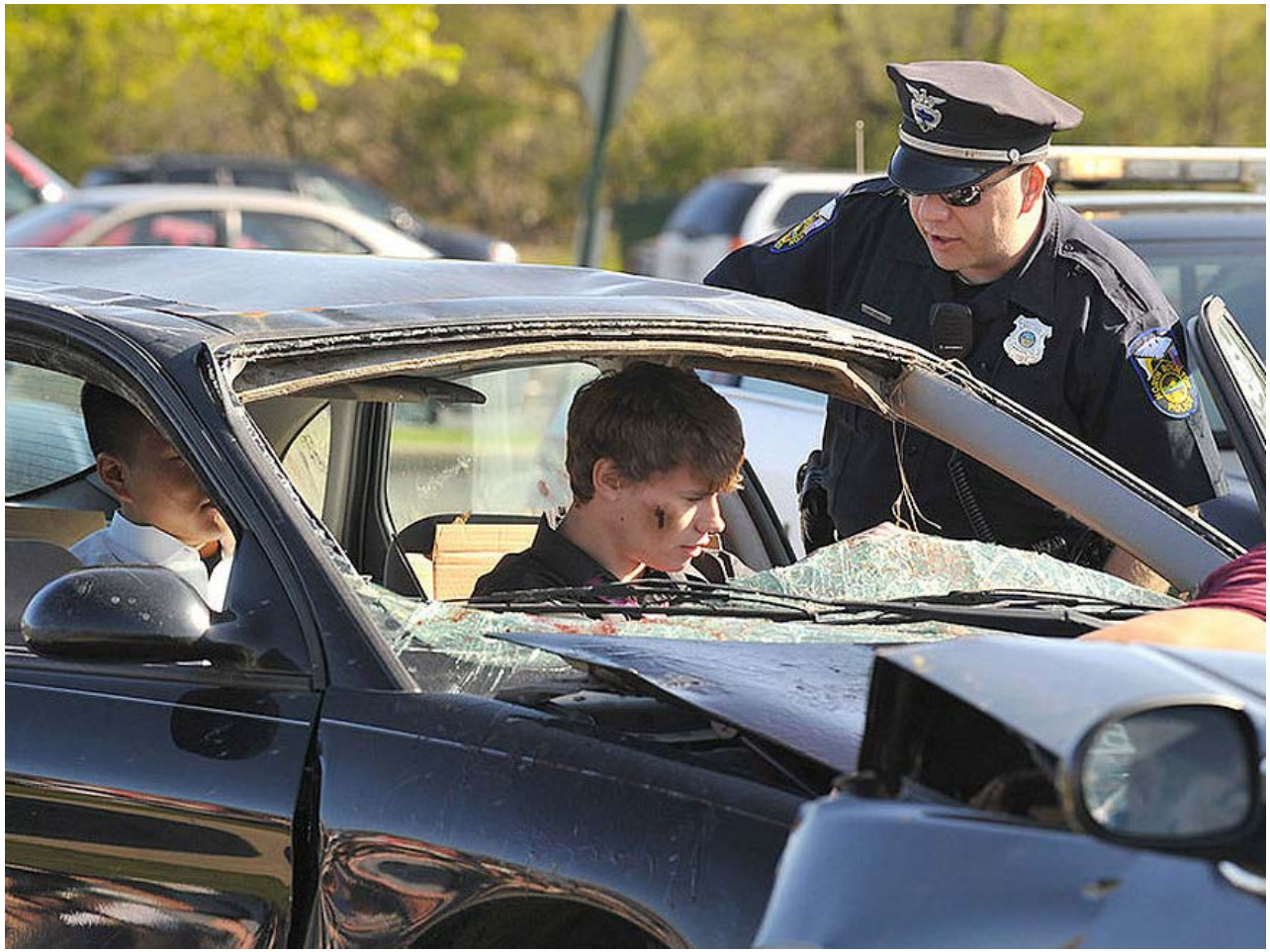
DESPITE SUCCESS, TOO MANY DEATHS/INJURIES



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ADOLESCENT DEATHS:
CRASHES ACCOUNT FOR 1 IN 3

" Conrad sped up, but it was so dark, he didn't see the pothole. Next thing I knew, we were flying through the air. ...My heart is broken and shattered."

– 17 year-old sole survivor, only occupant using belt

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ADDED THIRD FOCUS: PREVENT THE CRASH
(WITH DURBIN, CURRY, MCDONALD, AND OTHERS)

1. Prevent the **crash**

2. Given crash, prevent crash **injury**

3. **Resuscitate** and ensure **recovery & rehabilitation**

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BACKGROUND

Learner

Acquiring skills

Independent Driver

Inexperienced with skill deficits

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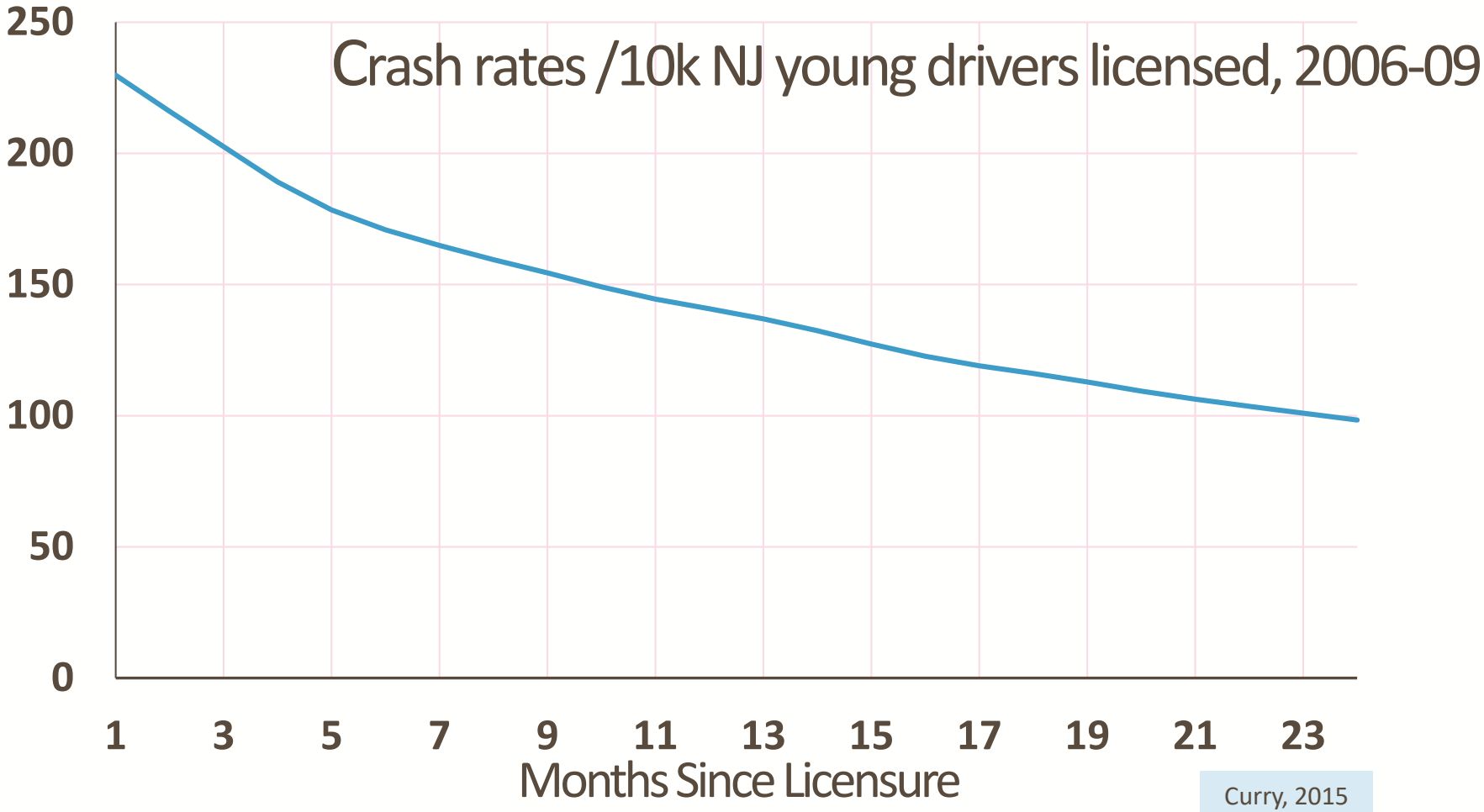
HIGHEST LIFETIME CRASH RATE
MONTHS AFTER LICENSURE



Curry, 2015

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CRASHES ARE NOT ACCIDENTS
HOW TO AVOID A CRASH

SCAN	DETECT	REACT
*Pay Attention *Scan •Far ahead •To the sides •In the rear *Anticipate Hazards	*Recognize & *Predict Hazards	*Decide to act *Choose action *Execute

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TEEN DRIVER CRASHES: POOR SKILL, INEXPERIENCE

RESEARCH WITH DURBIN, CURRY, MCDONALD, OTHERS

95% of teen crashes due to driver ERROR

Most Common Critical Errors "Big 3":

21% Scanning/hazard detection

21% Too fast for conditions

19% Distraction

Source: Curry, Hafetz, Kallan, Winston, Durbin Dennis. AAP 2011.

KEY FINDINGS

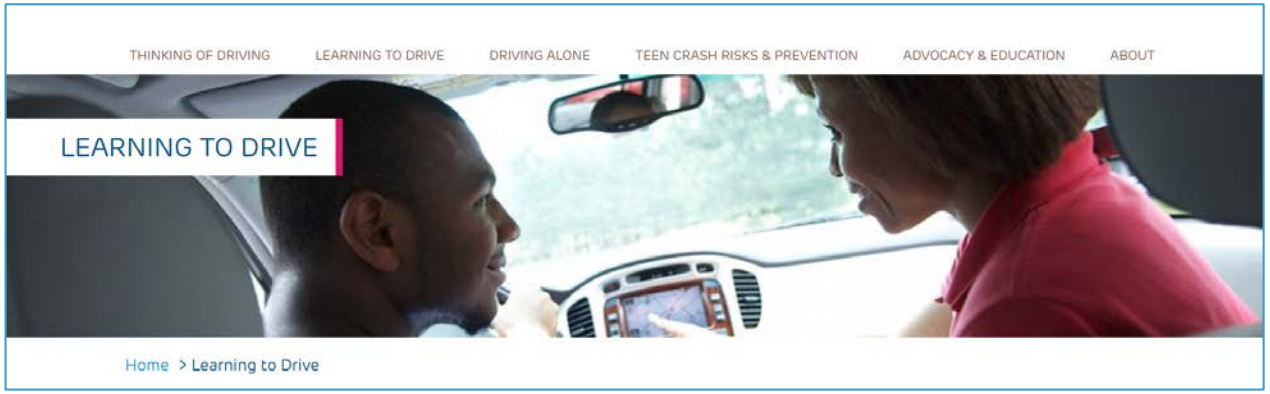
- Yes, peers matter, but so do parents.
  - If teen saw parent as supportive but having clear rules, **½ risk** of: crash, speeding, more.
- Novice teen crashes are not due to "invincibility".
  - Crucial to improve poor skills, inadequate experience.
- License ≠ adequate skill and experience
  - Need to focus on the "peri-license" period.
  - NEED better way to assess preparedness for safe driving.

ACTION

- Developed and evaluated resources for parents
  - Improve driving practice.
  - Improve monitoring after license.
- Advocated for upgraded licensing laws
- Spread messages through campaigns
  - Parents are important for safe teen driving.
  - Early licensure period is critical.
  - Quantity & variety of practice is needed.
  - Scanning and speed management are key skill deficits to address with novice drivers.

IMPACT: OUR RESEARCH INFORMED

- Advances in teen driver safety
  - Laws and National Teen Driver Safety Week
  - Increased role of parents in teen driver safety



RESOURCES

FOR PRACTICE DRIVING:	**Teen Driving Plan**
FOR PARENTS:	**teendriversource.org**
Simulator:	**Free assessments** (time permitting)

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CRITICAL NEED: ASSESS PREPAREDNESS
FOCUS ON TIME OF LICENSURE

Learner

Independent Driver

Time Zero

Independent driving

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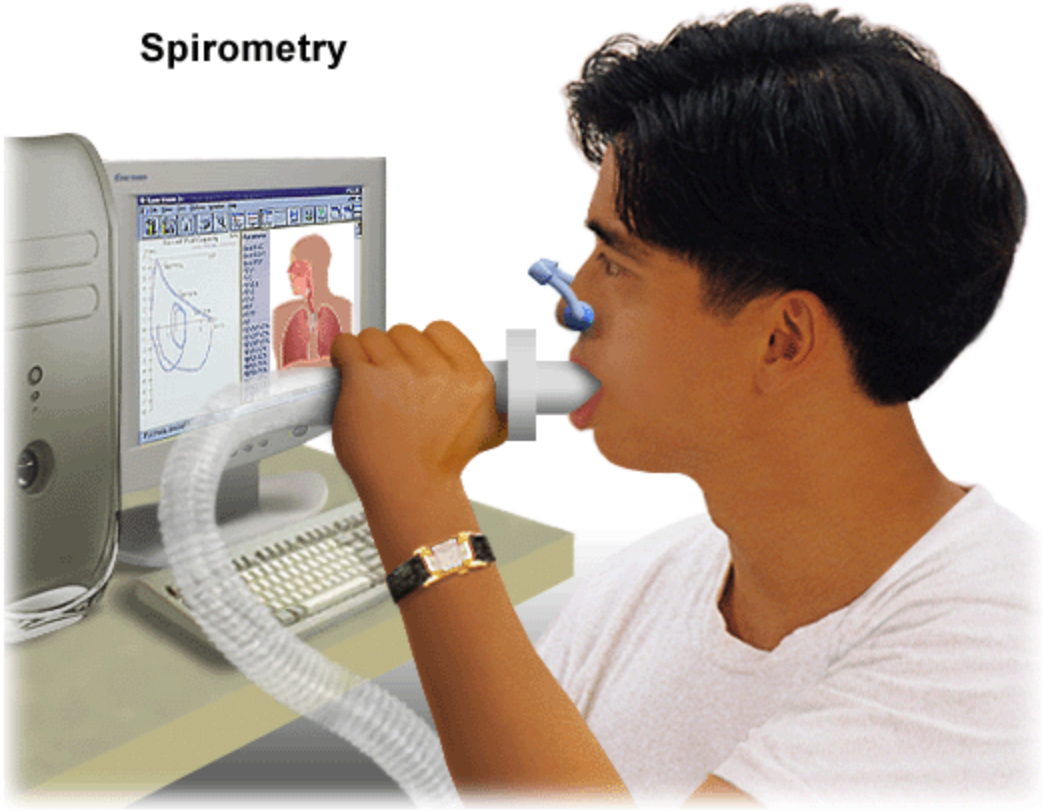
KEY ROLE FOR ASSESSMENT

- Asthma



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KEY ROLE FOR ASSESSMENT

- Cardiovascular Disease

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KEY ROLE FOR ASSESSMENT

- Driving

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CREATED A SIMULATED DRIVING ASSESSMENT

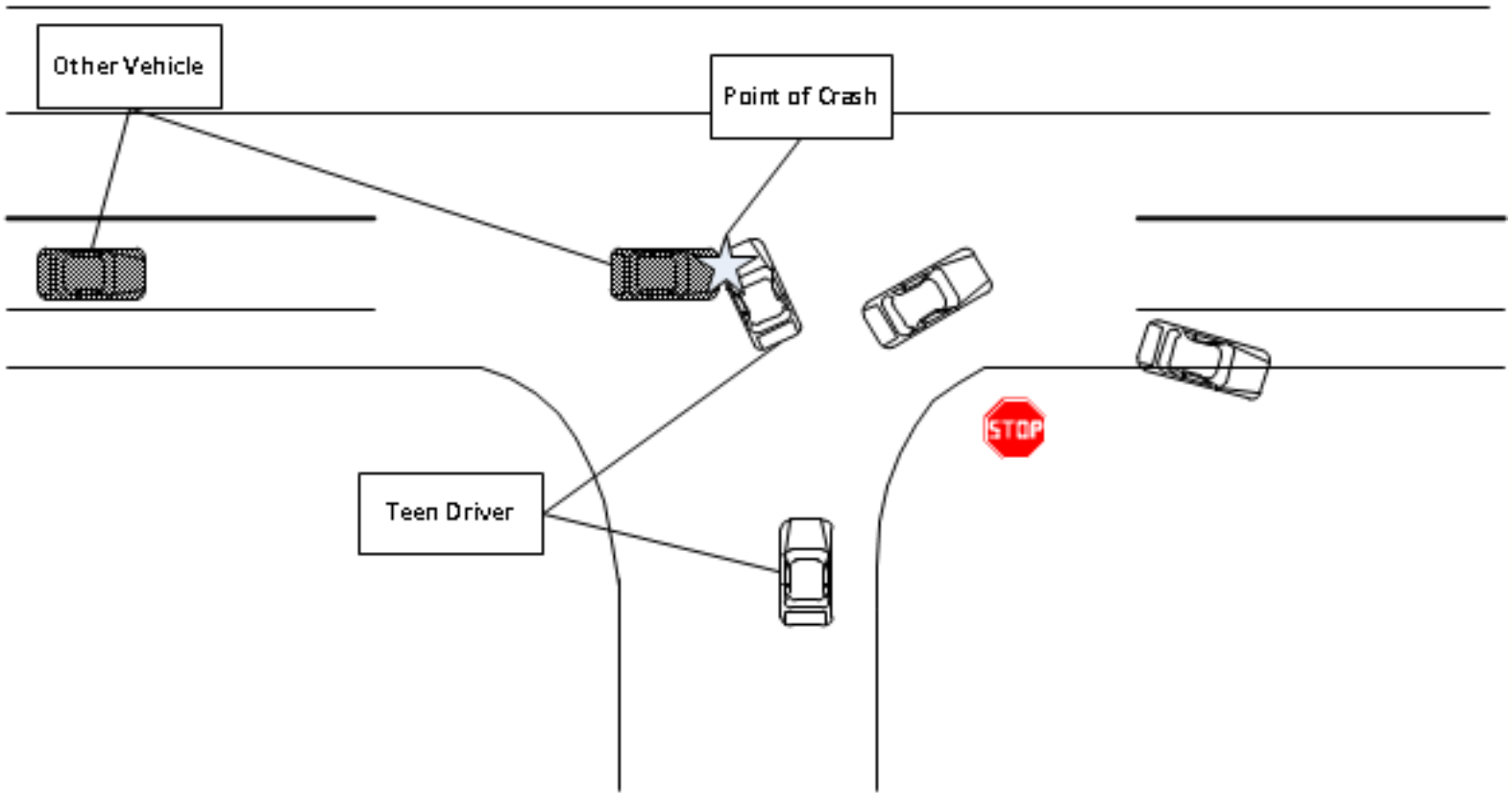
- **Scenarios**: Serious potential crash scenarios
  - from National Motor Vehicle Crash Causation Survey
- **Metrics**: Safety metrics
  - From literature and expert consultation
- **Validated**: Can distinguish drivers
  - Skilled/less skilled
  - Experienced/inexperienced
  - Police-reported crash history

DEVELOPMENT OF SIMULATED SCENARIOS

- Analysis of NHTSA data (NMVCCS) s:
  - 676 teen driver crashes
- Top 4 crash scenarios

Crash Type	Weighted %
Turn into opposite directions (turning left)	11.9%
Right roadside departure	10.3%
Rear-end collision	9.6%
Left roadside departure	9.6%

NMVCCS EXAMPLE: LEFT TURN ACROSS PATH



Exemplar scenario 1: Left turn at t-intersection with no obstruction
Note: Recreated in Visio from scenario drawing from http://wwwnass.nhtsa.dot.gov/nmvccs_pub/SearchForm.aspx for Case ID 2007005289982

BUT CRITICAL NEED: ASSESS PREPAREDNESS
DEVELOPED SIMULATED DRIVING ASSESSMENT
(WITH MCDONALD & OTHERS)

Standardized & Validated

- Differentiated young novice drivers from experienced adults.
- Correctly classified 87.5% adult driver history of police-reported crashes.
- Identified users with high simulated crash risk.
- Detected specific errors in skills associated with crashes.

McDonald, Winston et al. Injury Prevention 2015

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VALIDATED VIRTUAL DRIVING TEST
HOW DO WE HAVE IMPACT?

Inj Prev. 2015 Jun;21(3):145-52. doi: 10.1136/injuryprev-2014-041480. Epub 2015 Mar 4.

Simulated Driving Assessment (SDA) for teen drivers: results from a validation study.

McDonald CC[1], Kandadai V[2], Loeb H[2], Seacrist TS[2], Lee YC[2], Winston Z[2], Winston FK[3].

Author information

Abstract

BACKGROUND: Driver error and inadequate skill are common critical reasons for novice teen driver crashes, yet few validate assessments of teen driving skills exist. The purpose of this study is to evaluate the construct and criterion validity of a newly

Accid Anal Prev. 2014 Nov;72:302-8. doi: 10.1016/j.aap.2014.07.016. Epub 2014 Aug 5.

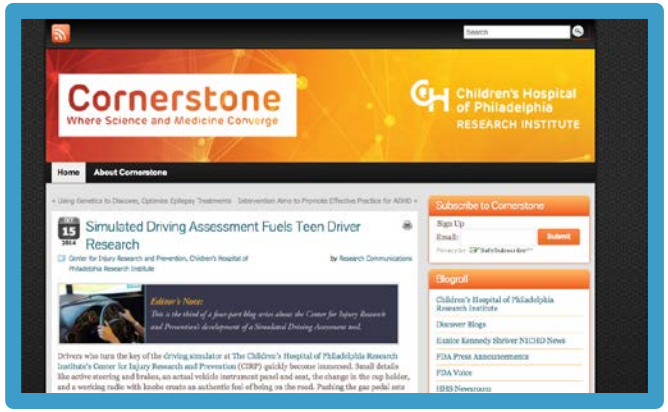
Comparison of teen and adult driver crash scenarios in a nationally representative sample of serious crashes.

McDonald CC[1], Curry AE[2], Kandadai V[3], Sommers MS[4], Winston FK[5].

Author information

Abstract

Motor vehicle crashes are the leading cause of death and acquired disability during the first four decades of life. While teen drivers have the highest crash risk, few studies examine the similarities and differences in teen and adult driver crashes. We aimed to: (1) identify and compare the most frequent crash scenarios-integrated information on a vehicle's movement prior to crash, immediate pre-crash event, and



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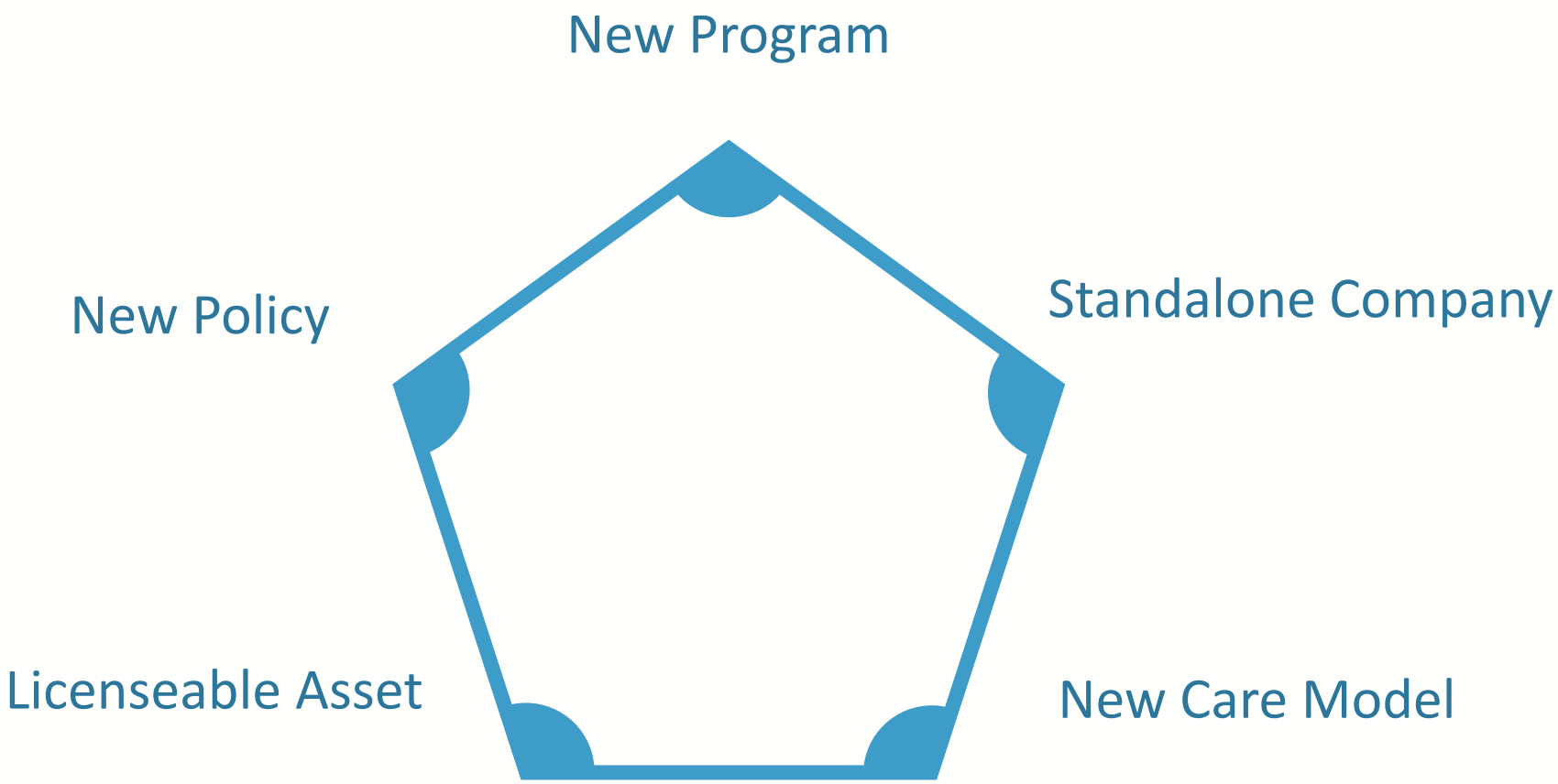
PATHS FROM DISCOVERY TO TRUE IMPACT



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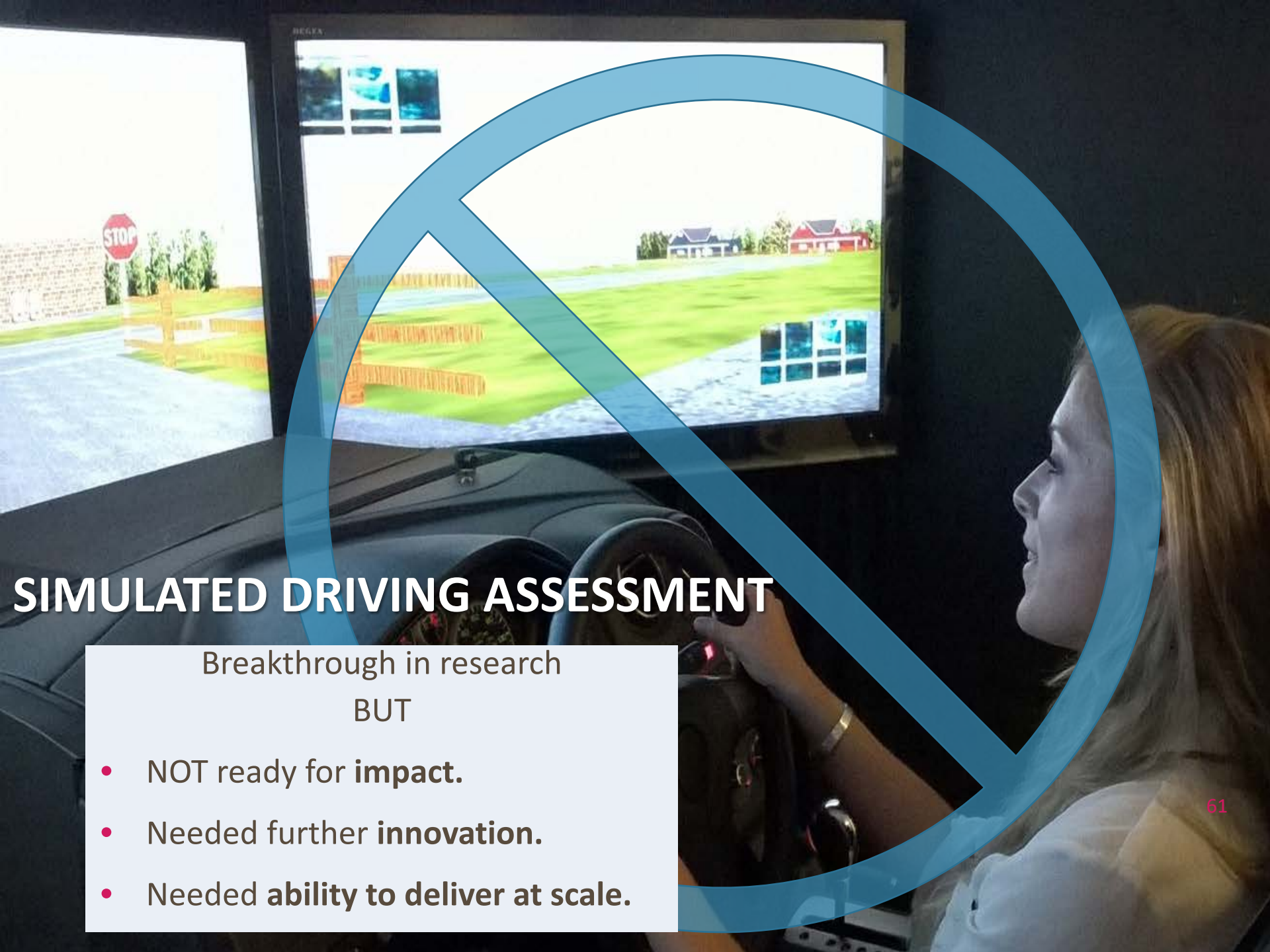


SIMULATED DRIVING ASSESSMENT

Breakthrough in research

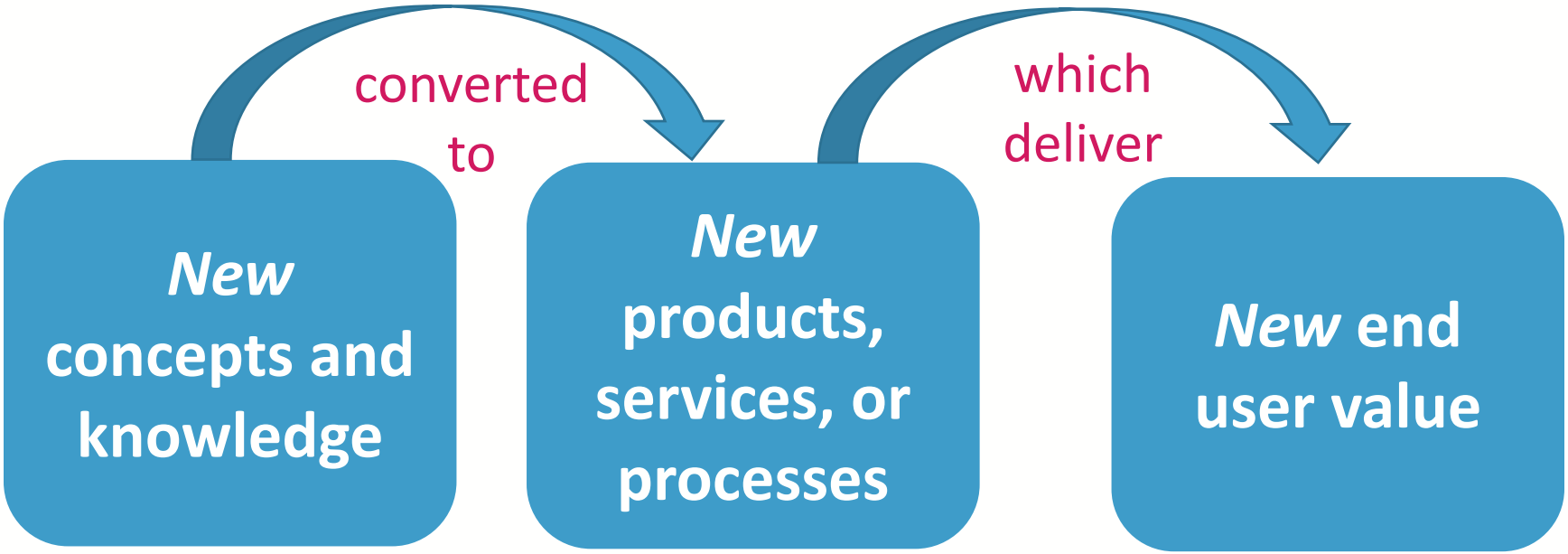
BUT

- NOT ready for **impact.**
- Needed further **innovation.**
- Needed **ability to deliver at scale.**

BREAKTHROUGH VERSUS INNOVATION?
INNOVATION: IN A NEW WAY

innovate (v.)

1540s, "introduce as new“ (latin: *innovatus)*



Source: https://www.etymonline.com/word/innovate

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WHAT IS A TRUE OPPORTUNITY FOR IMPACT?
DELIVERING INNOVATION, NEW VALUE

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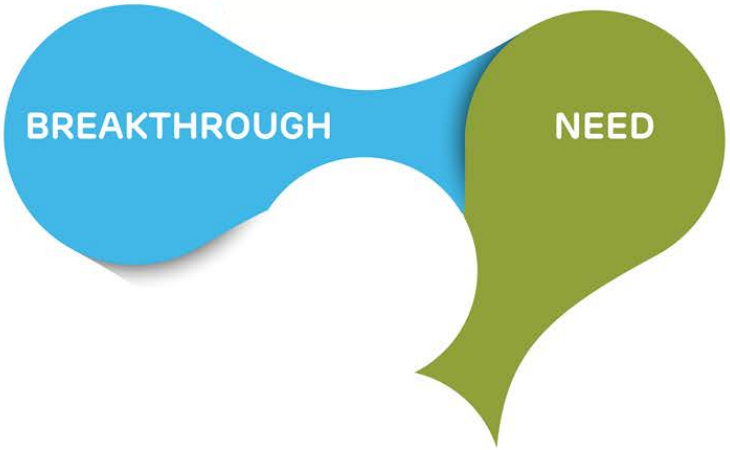
BREAKTHROUGH, NEED, ~~NO DELIVERY~~

PRODUCT/SERVICE THAT CAN'T BE DELIVERED



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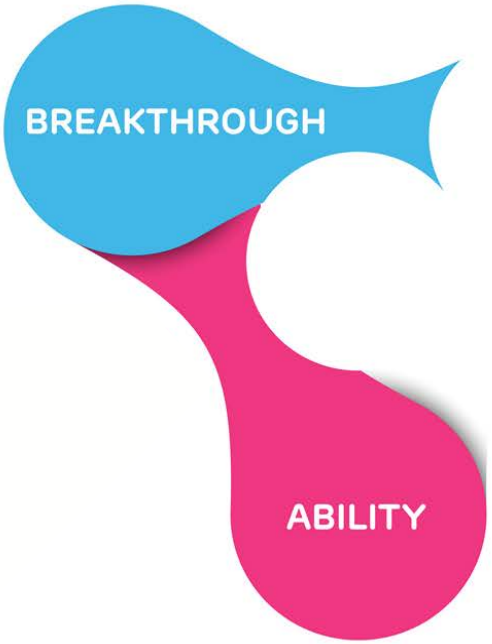
BREAKTHROUGH, DELIVERY, ~~NO NEED~~

PRODUCT/SERVICE NO ONE WANTS



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ABILITY, NEED, ~~NO BREAKTHROUGH~~

UNFOCUSED PRODUCT/SERVICE

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NEED: MAKE TEST PORTABLE & DELIVER IT

PIVOT: FOCUS ON PRODUCT & PARTNERS

(WITH KANDADAI & OTHERS)

CHOP Research + **CHOP Investment** = Portable Virtual Driving Test Spin-out Company

Protected time
Product development
Evaluation
Grow team

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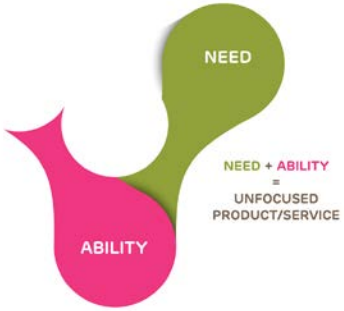
PARTNER: OHIO HAD THE NEED AND THE ABILITY TO DELIVER



OHIO NEED (RFA): Virtual Driving Test to enhance licensing exam

OHIO ABILITY: Network of licensing centers

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VDT AND OHIO

BREAKTHROUGH + NEED + DELIVERY =
OPPORTUNITY TO REDUCE CRASHES

being used by

OHIO DEPARTMENT OF PUBLIC SAFETY
SAFETY · SERVICE · PROTECTION

OHIO BMV

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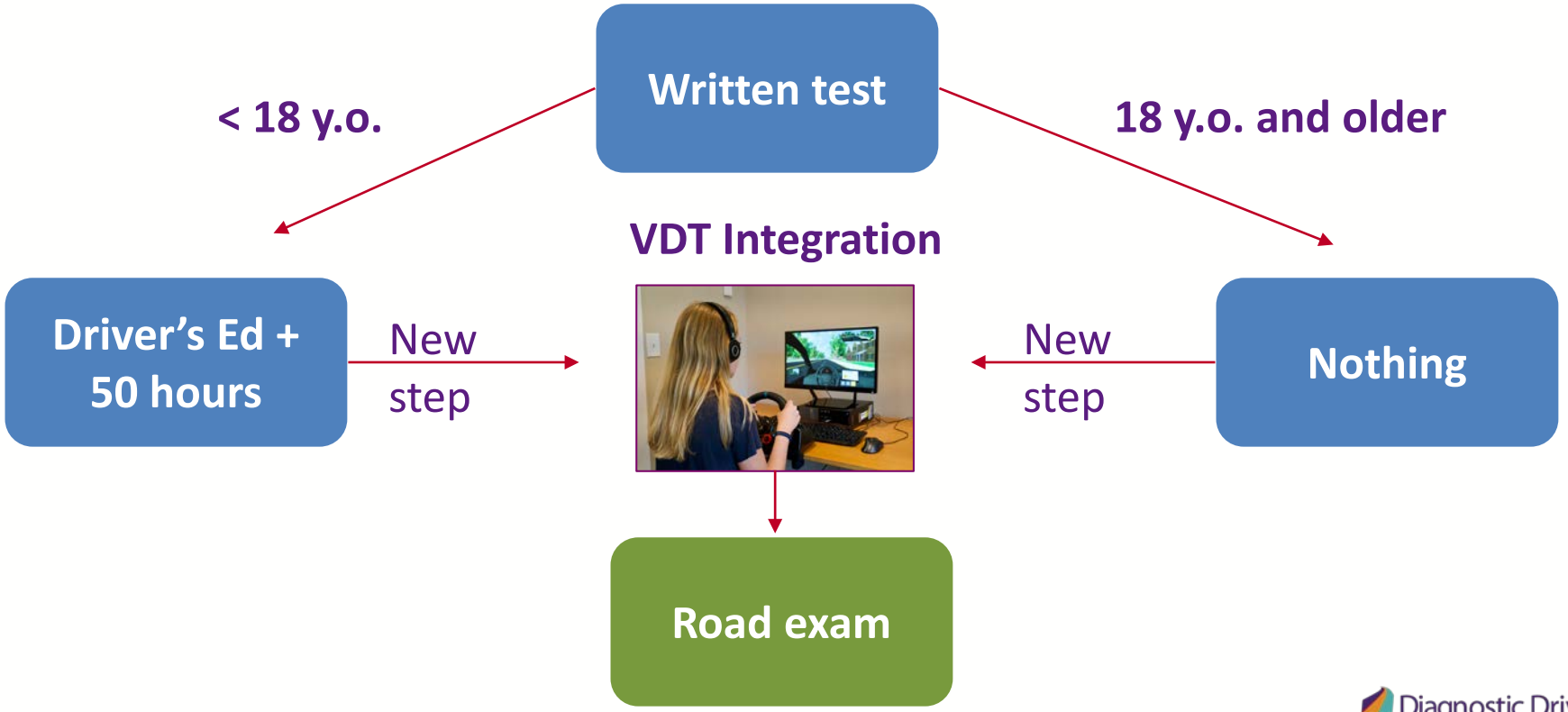
RESEARCH INTEGRATED INTO WORKFLOW



Diagnostic Driving

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BUT THE RESEARCH ISN'T DONE

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TEEN DRIVER OUTCOME:
OBVIOUS? NO!

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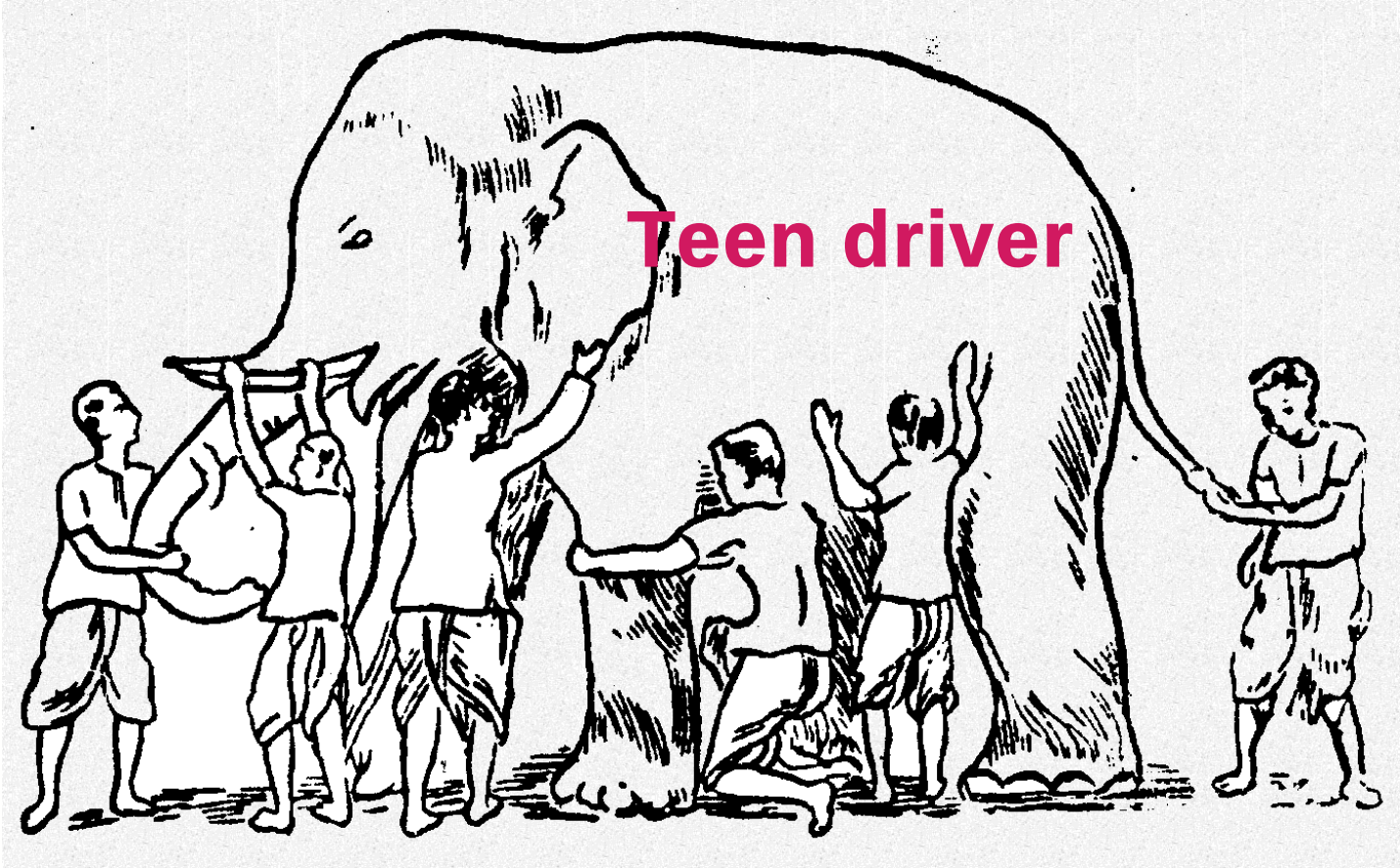
GAP: CAUSES OF CRASH RISK

PIVOT: VDT AS PROBE - NEUROSCIENCE

(NEUROSCIENCE WITH ROMER, ROBERTS, WALSHE, GAETZ)



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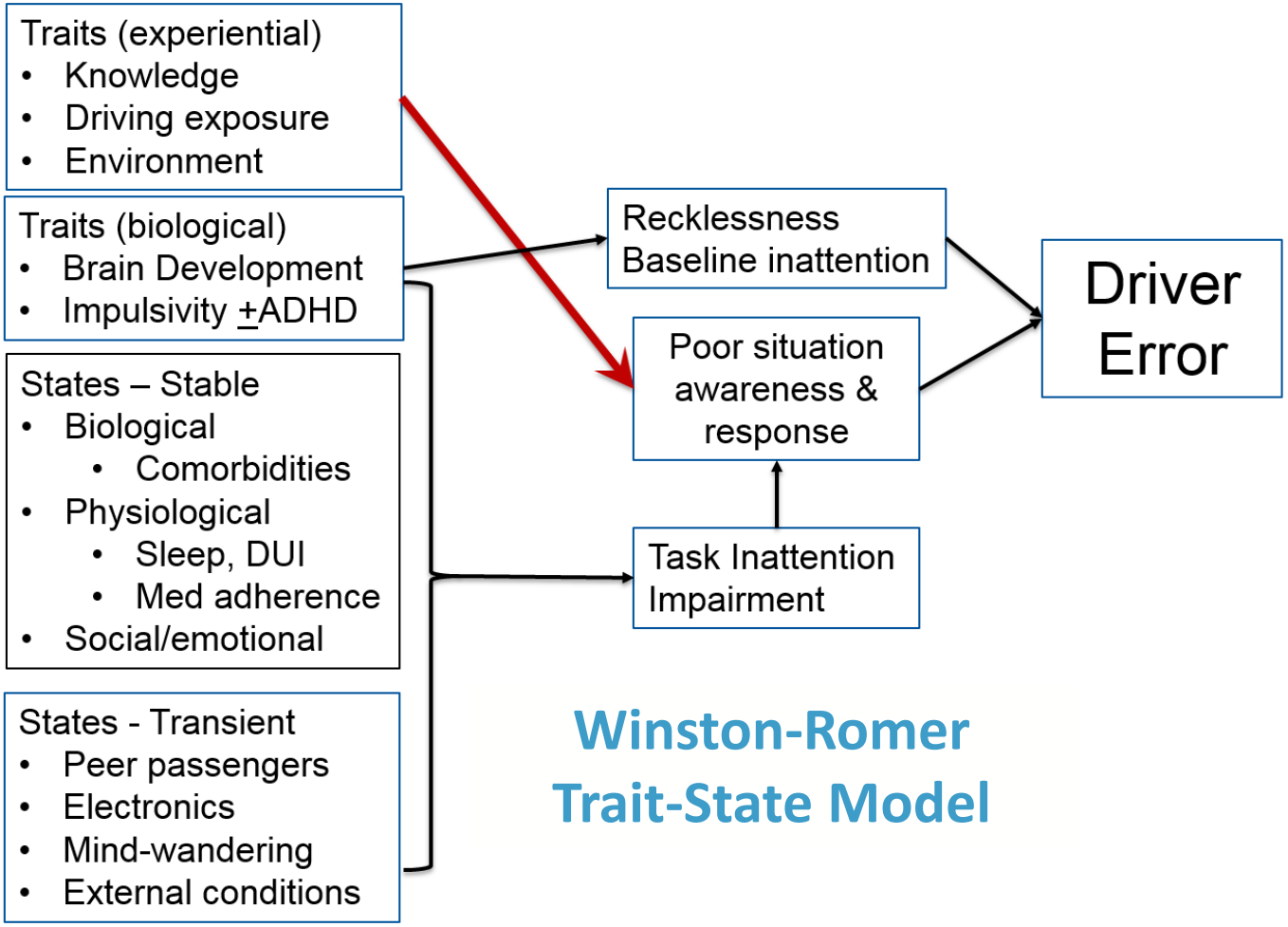
THEORETICAL FOUNDATION



Winston-Romer Trait-State Model

Romer, Winston, et al. Journal Adol Health 54:5 (2014), S6-15.

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CONVERGENCE NEUROSCIENCE OF DRIVING
ENABLED BY THE VDT

- POPULATION LEVEL DATA
  - VDT in licensing workflow
  - Licensing/crash outcomes

- CLINIC LEVEL DATA
  - VDT in clinical workflow
  - Medical and testing data

- NEUROSCIENCE RESEARCH DATA
  - VDT used in research studies

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BEYOND INJURY
MANY DISCOVERIES, NEED MORE IMPACT

PIVOT: CHOP INNOVATION ECOSYSTEM
(WITH WOLF, AGOSTO, ROBERTS, FERRO, CHINWALLA, MCCABE, SULLIVAN, SZE, BRADSHAW, HILL, OPPENHEIMER, ROSENBERG, AND MANY MORE)

- NIH/NICHD FY17 budget: $1,316,607,000
- >13,000 Pediatric articles in 2016

  Google Scholar search (pediatric, child, adolescent, teen)
- Not enough impact

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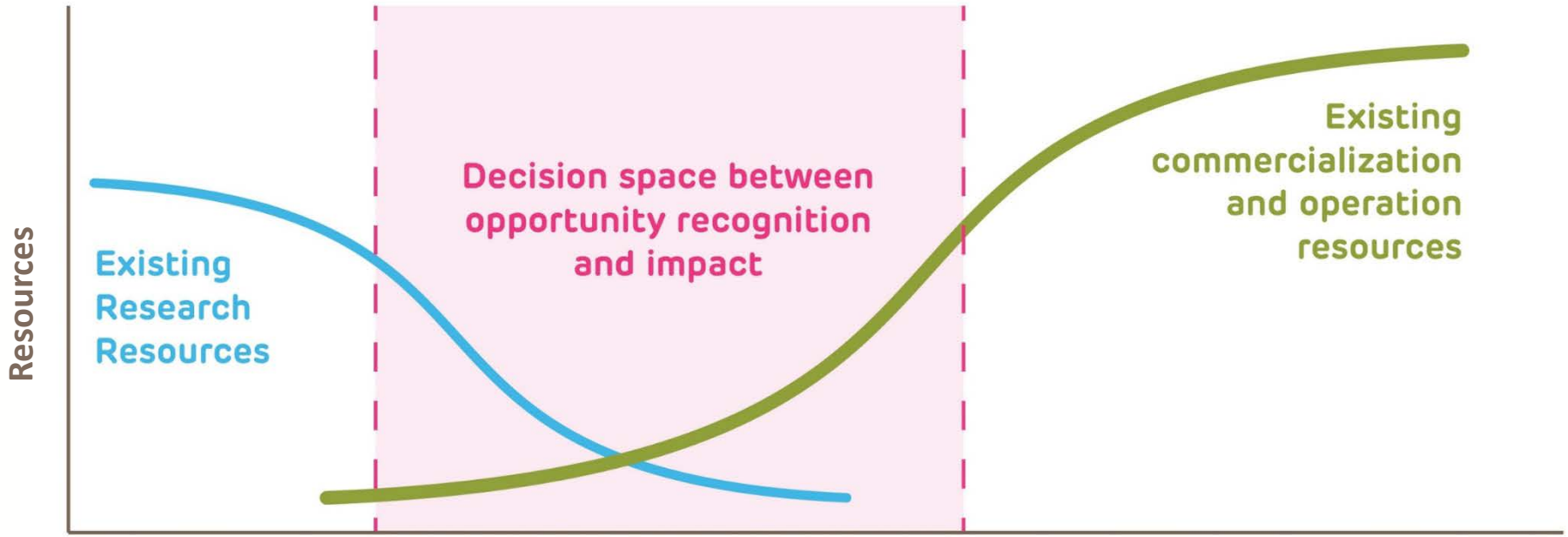
CHALLENGE: CROSSING THE "VALLEY OF DEATH"



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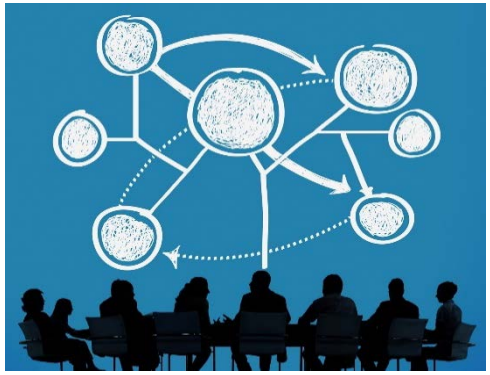
CHOP INNOVATION ECOSYSTEM VISION STATEMENT



We aim to create a
connected innovation ecosystem
that recognizes the
full value & experience of people & teams,
and places everyone at CHOP within
one degree of separation from a resource
who can guide them from
breakthrough to impact
and help their
ideas succeed.

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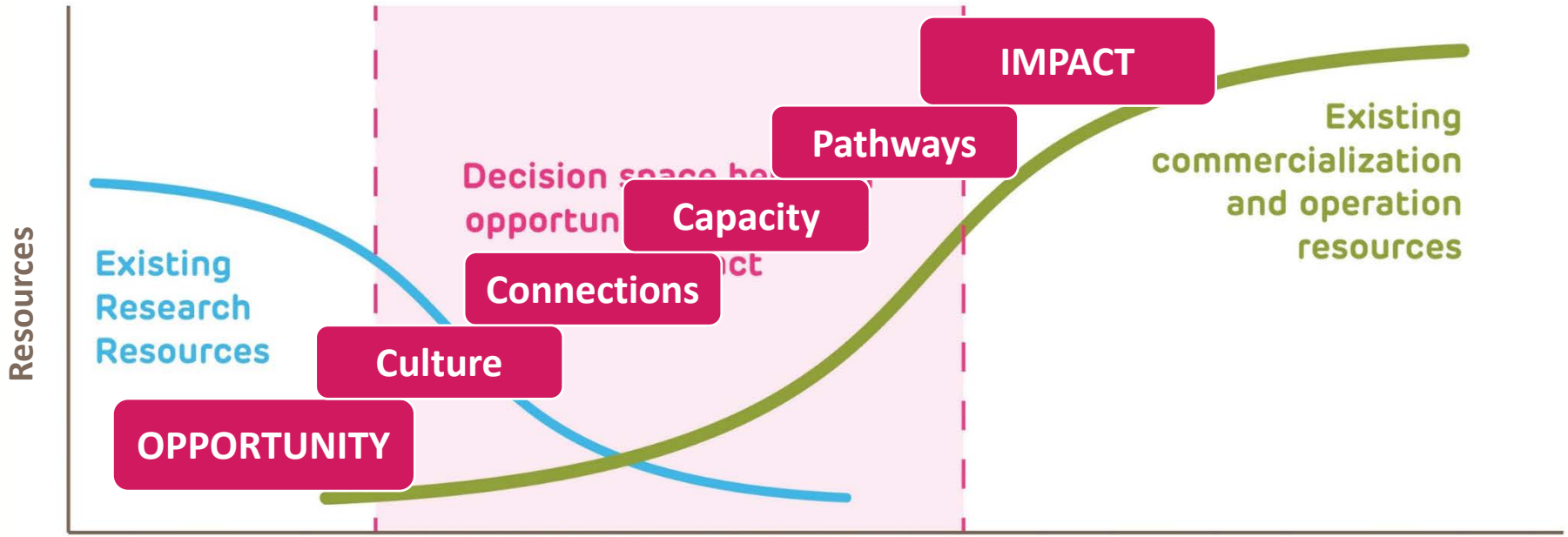
CONVERT VALLEY OF DEATH → CHALLENGE BASIN



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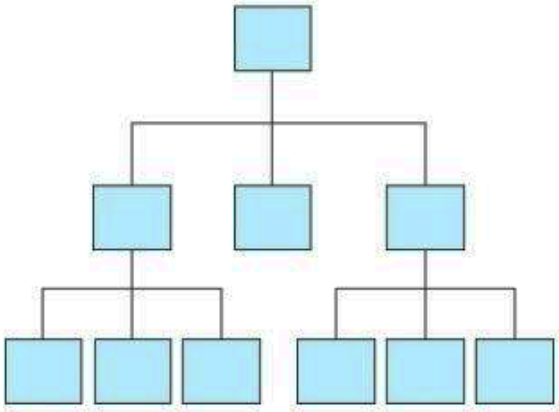
CONNECTIONS:

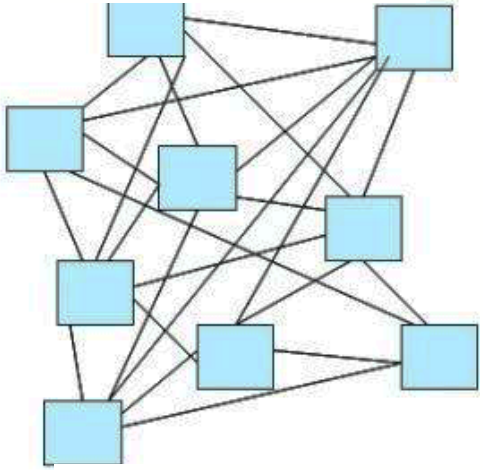
NEED TO REVEAL AND SUPPORT INFORMAL NETWORK

Hierarchical organization structure



- Management
- Accountability
- Consistency
- Safety

Informal network



- Interconnected
- Creativity
- Innovation
- New value
- Resilient

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CAPACITY:

PROVIDE JUST-IN-TIME TRAINING/CONSULTING DELIVERED AT SCALE

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CULTURE:

LEARN FROM AND SHARE FAILURES (AND SUCCESSES)
INNOVATE WHILE DELIVERING CONSISTENCY
SOLUTION FOR (RATHER THAN CONTRIBUTING TO) BURNOUT

"The temptation to lead as a chess master, controlling each move of the organization, must give way to an approach as a gardener, enabling rather than directing."

- Gen. Stan McChrystal

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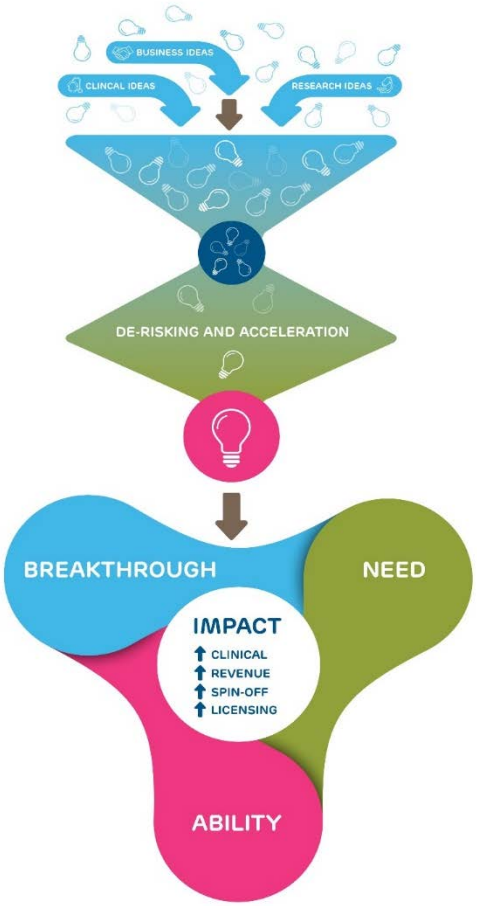
FORMALIZING INNOVATION PATHWAYS



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KEY TAKEAWAY: DON'T BE AFRAID TO

BUT FOR IMPACT:

PARTNER TO EFFECT CHANGE.

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