



# Methods: Mind the Gap Webinar Series

## Optimization of Prevention Interventions Using MOST: State of the Science and Future Directions

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Presented by

**Linda M. Collins, Ph.D.**

Penn State University



# Optimization of prevention interventions using MOST: State of the science and future directions

Linda M. Collins, Ph.D.  
The Methodology Center and  
Department of Human Development & Family Studies  
Penn State

# Massive improvements in technology over the past 30 years

Late 20<sup>th</sup> century  
(mid 1980's)



Early 21<sup>st</sup> century  
(today)

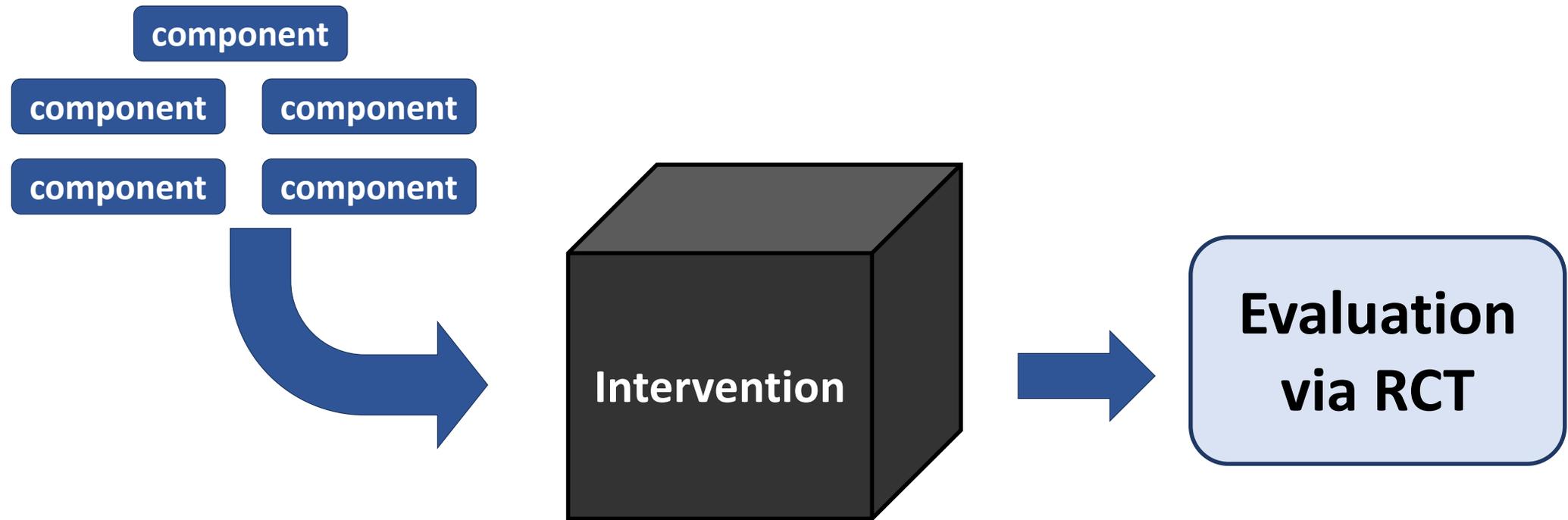


**Have prevention interventions  
improved this much?**

# Outline

- “Business as usual” compared to a new perspective
- Where are they now? Two projects I mentioned in my 2013 Mind the Gap talk
  - Smoking cessation
  - Weight reduction
- State of the science and future directions

# “Business as usual:” Classical treatment package approach



# An RCT that finds a significant effect DOES NOT provide information about:

- Which components are making positive contributions to overall effect
- Whether the inclusion of one component has an impact on the effect of another
- Whether a component's contribution offsets its cost
- How to make the intervention more effective, efficient, and scalable

# An RCT that finds a non-significant effect DOES NOT provide information about:

- Whether any components are worth retaining
- Whether one component had a negative effect that offset the positive effect of others
- Specifically what went wrong and how to do it better the next time

# Desiderata for a behavioral/biobehavioral intervention

- Effectiveness
  - Extent to which the intervention does more good than harm (under real-world conditions; Flay, 1986)
- Efficiency
  - Extent to which the intervention avoids wasting time, money, or other valuable resources
- Economy
  - Extent to which the intervention is effective without exceeding budgetary constraints, and offers a good value
- Scalability
  - Extent to which the intervention can be implemented in the intended setting exactly as evaluated

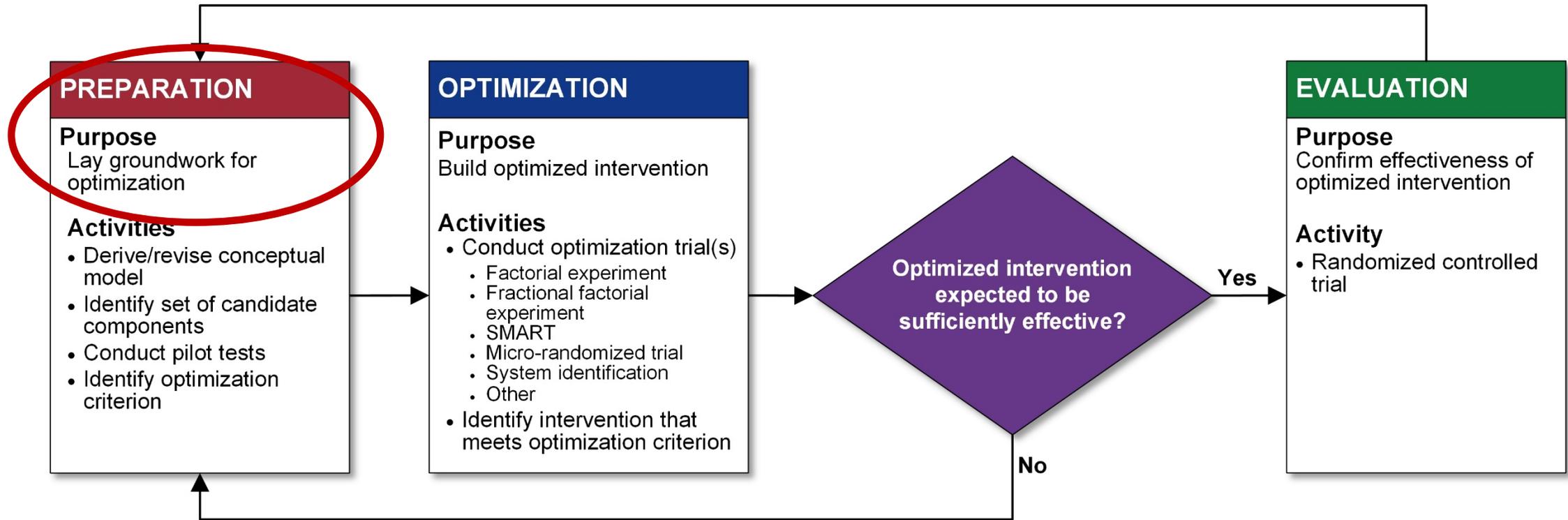
# Optimization of an intervention is:

- *The process of identifying the intervention that provides the best expected outcome obtainable...*
- *...within key constraints imposed by the need for efficiency, economy, and/or scalability.*

# The multiphase optimization strategy (MOST)

- An engineering-inspired framework for development, optimization, and evaluation of interventions
- Using MOST it is possible to engineer an intervention to meet a specific criterion

Continual optimization principle



Resource management principle

**Flow chart of the three phases of the multiphase optimization strategy (MOST). Rectangle = action. Diamond = decision.**

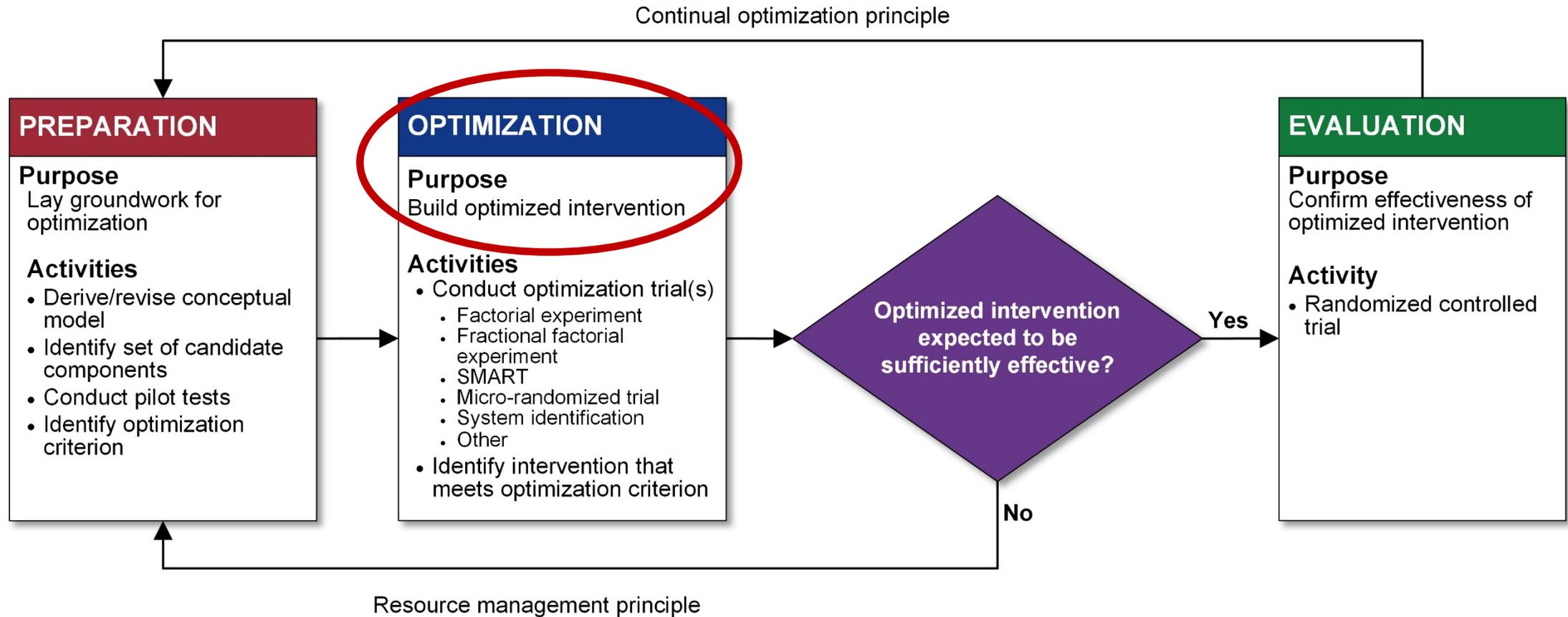
Figure taken from Collins, L.M. (2018). *Optimization of Behavioral, Biobehavioral, and Biomedical Interventions: The Multiphase Optimization Strategy (MOST)*. New York: Springer.

# Phases of MOST:

## Preparation, optimization, evaluation

### Preparation

- Purpose: to lay groundwork for optimization
  - Review prior research, take stock of clinical experience, conduct secondary analyses, etc.
  - Derive conceptual model
  - Select intervention components to examine
  - Conduct pilot/feasibility work
  - Identify clearly operationalized optimization criterion



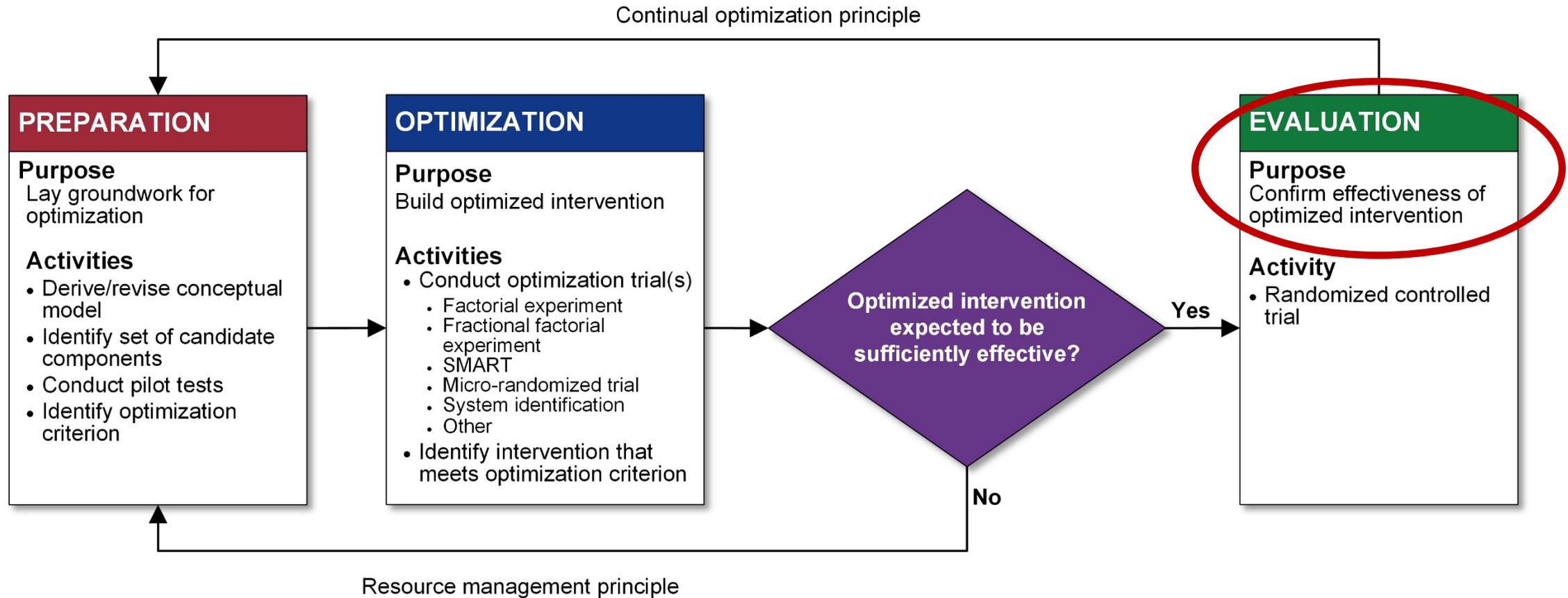
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# Phases of MOST: Preparation, **optimization**, evaluation

## Optimization

- Objective: To form a treatment package that meets the optimization criterion
  - Collect and analyze empirical data on performance of individual intervention components relying on efficient randomized experiments
  - Based on information gathered, select components and levels that meet optimization criterion.



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# Phases of MOST: Preparation, optimization, **evaluation**

## Evaluation

- Objective: To establish whether the optimized intervention has a statistically significant effect compared to a control or alternative intervention
  - Conduct an RCT

# Some differences in perspective between the classical approach and MOST

## *Objective*

- **Classical approach**
  - To develop an intervention that demonstrates a statistically and clinically significant effect in an RCT
- **MOST**
  - To develop an intervention that
    - Demonstrates a statistically and clinically significant effect in an RCT AND
    - Meets specific predetermined standards of effectiveness, efficiency, cost-effectiveness, and/or scalability

# Some differences in perspective between the classical approach and MOST

## *Next steps after identification and pilot testing of components*

- **Classical approach**
  - An intervention is assembled and then evaluated as a package in an RCT
- **MOST**
  - An optimization trial is conducted and an optimized intervention is built

# Some differences in perspective between the classical approach and MOST

## *Experimental designs used*

- **Classical approach**
  - Primarily the RCT
- **MOST**
  - For the optimization trial
    - Experimental designs selected based on resource management principle.
  - For evaluation of intervention as a package
    - Primarily the RCT

# Some differences in perspective between the classical approach and MOST

## *Examination of effectiveness of individual intervention components*

- **Classical approach**
  - Conducted primarily via post-hoc analyses on data from RCT
- **MOST**
  - Conducted primarily via experimental manipulation of components

# Some differences in perspective between the classical approach and MOST

## *Inclusion of inert or counterproductive components*

- **Classical approach**
  - Generally tolerated as long as overall effectiveness of intervention can be demonstrated
- **MOST**
  - Generally not tolerated because such components reduce efficiency

# Some possibilities offered by MOST

- Engineer interventions to be cost-effective
- Engineer interventions to be immediately scalable and sustainable
- Based on one optimization trial, optimize using different criteria for different situations

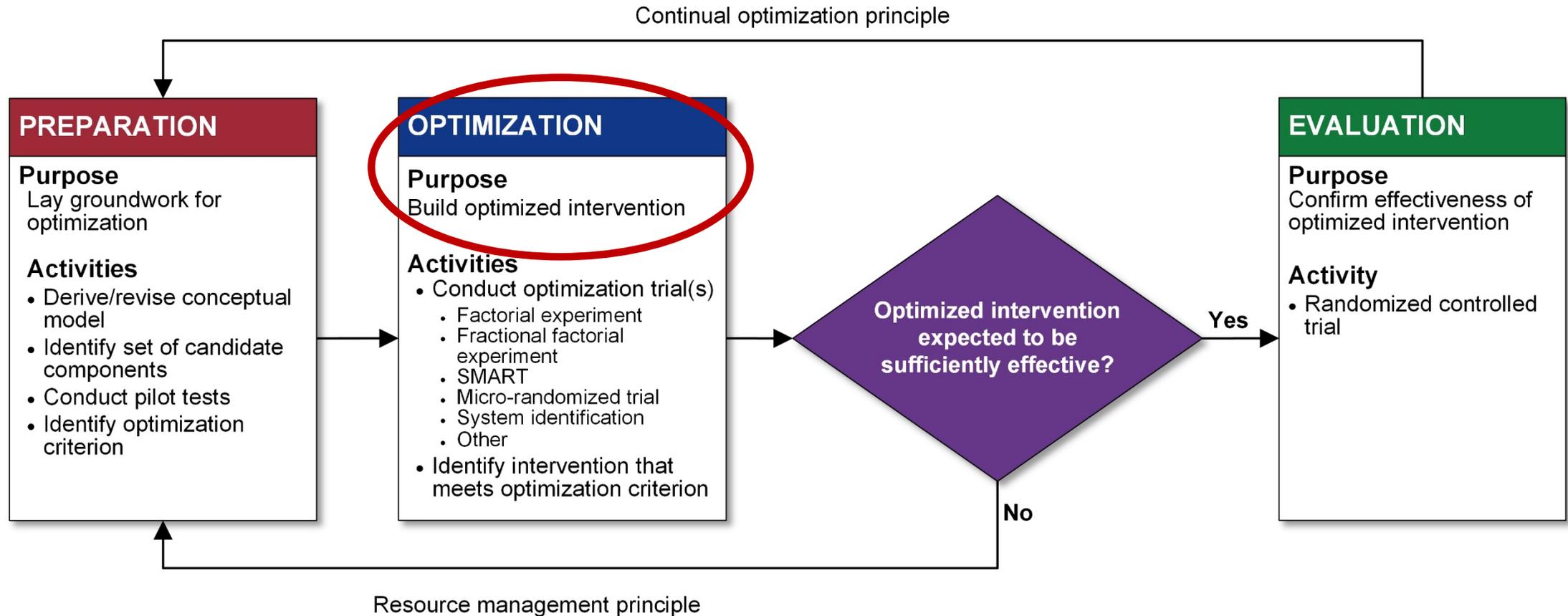
# Outline

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- Where are they now? Two projects I mentioned in my 2013 Mind the Gap talk
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# Where are they now?

## Example: Primary-care-based smoking cessation study

- PIs: Mike Fiore and Tim Baker, University of Wisconsin
- Investigators include Robin Mermelstein (University of Illinois, Chicago), Megan Piper (UW), and me
- Funded by NCI, P50 CA143188 and P01 CA180945
- First full cycle of MOST
  
- Piper et al. (2018), *Annals of Behavioral Medicine*; Baker et al. (2017), *Behavior Therapy*; Piper et al. (2017a,b), *Drug and Alcohol Dependence*; Baker et al. (2016), *Addiction*; Cook et al. (2016), *Addiction*; Schlam et al. (2016), *Addiction*; Piper et al. (2016), *Addiction*; Collins et al. (2014), *Translational Behavioral Medicine*...



**Flow chart of the three phases of the multiphase optimization strategy (MOST). Rectangle = action. Diamond = decision.**

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# Three optimization trials

1. Focused on the weeks leading up to and immediately following quit date (6 components)
2. Focused on maintaining abstinence after the quit date (5 components)
3. One focused on smokers not yet ready to quit (4 components)

# Components being examined in Optimization Trial 1

Component	Higher (intensive) level	Lower level
Precessation nicotine patch	Yes	No
Precessation ad lib oral NRT (gum)	Yes	No
Precessation counseling	3 20-min sessions (2 in-person, 1 phone)	No
Cessation in-person counseling	3 20-min sessions	1 3-min session
Cessation telephone counseling	3 15-min sessions	1 10-min session
Maintenance medication duration starting at quit date (combo NRT)	16 weeks	8 weeks

# Three optimization trials, 15 components

1. Focused on the weeks leading up to and immediately following quit date (6 components) Design:  $2^{6-1}$
2. Focused on maintaining abstinence after the quit date (5 components) Design:  $2^5$
3. One focused on smokers not yet ready to quit (4 components) Design:  $2^4$

# Components/levels selected based on optimization trial

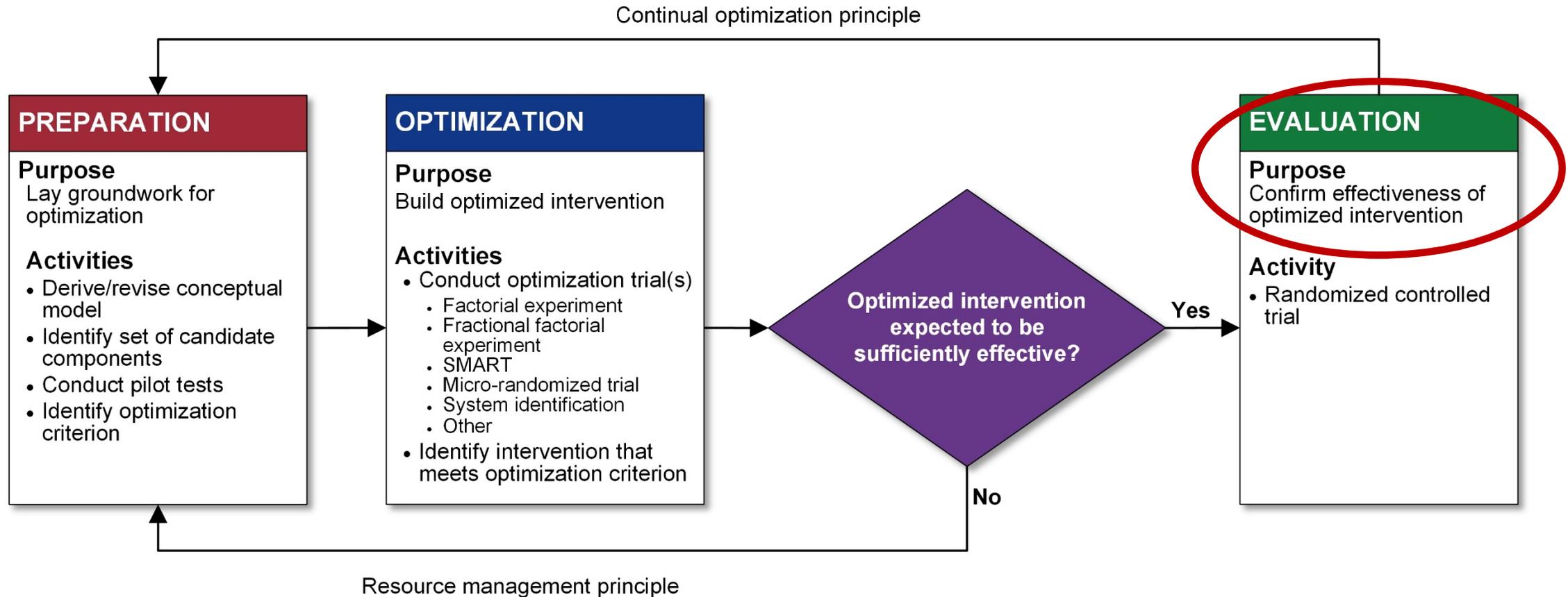
Based on the results of experimentation on 15 components, 5 “winners”:

*From the optimization trial I described:*

1. Precessation oral NRT
2. Cessation phase in-person counseling at intensive level

*From trial 2, on maintenance:*

3. Extended medication (26-week postquit combination NRT)
4. Maintenance phase counseling telephone calls
5. Maintenance phase automated adherence calls



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**Table 2** Seven-day point-prevalence abstinence rates over time for both treatment groups

Abstinence type	Time	Recommended usual care	Abstinence-optimized treatment	OR	95% CI	<i>p</i> -Value
Self-reported	Week 4	28.6	43.8	1.95	1.40, 2.72	<.001
	Week 8	23.8	46.4	2.77	1.97, 3.91	<.001
	Week 16	24.4	50.0	3.09	2.20, 4.35	<.001
	Week 26	18.4	39.3	2.87	1.99, 4.13	<.001
	Week 39	18.7	37.0	2.55	1.77, 3.68	<.001
	Week 52	16.2	32.8	2.53	1.72, 3.70	<.001
CO-confirmed (<6 ppm)	Post-week 26	6.0	15.9	2.95	1.69, 5.14	<.001

ann. behav. med. (2018) 52:854–864  
 DOI: 10.1093/abm/kax059

REGULAR ARTICLE

## A Randomized Controlled Trial of an Optimized Smoking Treatment Delivered in Primary Care

Megan E. Piper, PhD<sup>1,2</sup> • Jessica W. Cook, PhD<sup>1,2,3</sup> • Tanya R. Schlam, PhD<sup>1,2</sup> • Douglas E. Jorenby, PhD<sup>1,2</sup> • Stevens S. Smith, PhD<sup>1,2</sup> • Linda M. Collins, PhD<sup>4,5</sup> • Robin Mermelstein, PhD<sup>6</sup> • David Fraser, MS<sup>1</sup> • Michael C. Fiore, MD, MPH, MBA<sup>1,2</sup> • Timothy B. Baker, PhD<sup>1,2</sup>

# Outline

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# Where are they now?

## Example: Adult weight reduction

- PIs: Bonnie Spring (Northwestern University) and me
- Funded by NIDDK, R01 DK097364
- Pellegrini, C.A., Hoffman, S.A., Collins, L.M., & Spring, B. (2014), *Contemporary Clinical Trials*; Pellegrini, C.A., Hoffman, S.A., Collins, L.M., & Spring, B. (2015), *Contemporary Clinical Trials*.
- Everyone got a core intervention consisting of:
  - Education
  - Goal setting
  - Skill building
  - Tech tools

# Components examined in optimization trial

Component	Higher (intensive) level	Lower level
Telephone-delivered coaching	24 sessions	12 sessions
Text messages	Yes	No
Primary care physician communication	Yes	No
Buddy training	Yes	No
Meal replacement recommendations	Yes	No

Optimization trial used a 2<sup>5</sup> factorial design

# Some results of the optimization trial

- Buddy Training had a significant main effect
  - Select buddy training
- No difference between 12 and 24 coaching sessions
  - Select 12 sessions
- 3-way interaction involving Buddy Training, PCP communication, and text messages suggested PCP communication should be included (even though no main effect for this component)
- Without regard for cost:
  - Buddy training, PCP communication, 12 sessions of coaching
- NEXT we are incorporating information about cost

# Outline

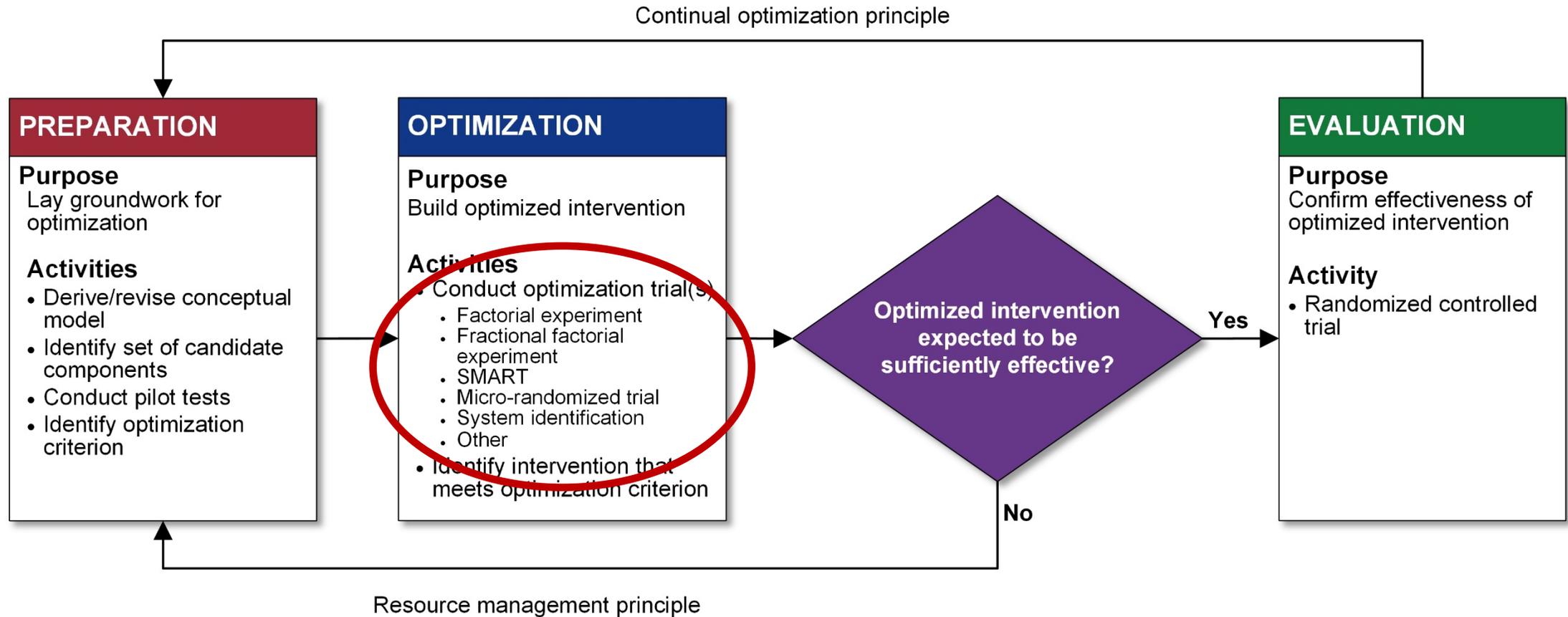
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# The state of the science

- At least 86 projects involving optimization trials funded by 14 different NIH ICs
- NIH funding announcements are increasingly mentioning intervention optimization
- Evidence of interest in many other countries
  
- BUT definitely not the norm

# Future directions: Decision-making and cost considerations

- Wide open area: Decision-making based on results of optimization trial
  - What do you do when you have
    - Several outcome variables
    - Several different costs
    - All of these in different metrics
- Where I am going now: integration of ideas from economic analysis, particularly multi-criteria decision analysis



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# Future directions: Experimental designs for optimization trials

- Further developments in experimental design
  - Sequential multiple-assignment randomized trial (SMART)
    - Daniel Almirall, U of Michigan
    - Billie Nahum-Shani, U of Michigan
  - Micro-randomized trials
    - Susan A. Murphy, Harvard
    - Pedrag Klasnja, U of Michigan
  - Control engineering perspective
    - Eric Hekler, UC San Diego
    - Daniel Rivera, Arizona State

# Future directions: More applications

- More areas of public health
- Exciting opportunities in implementation science

Statistics for Social and Behavioral Sciences

Linda M. Collins

# Optimization of Behavioral, Biobehavioral, and Biomedical Interventions

The Multiphase Optimization Strategy  
(MOST)

 Springer

Statistics for Social and Behavioral Sciences

Linda M. Collins · Kari C. Kugler  
*Editors*

# Optimization of Behavioral, Biobehavioral, and Biomedical Interventions

Advanced Topics

 Springer