The University of Utah
Department of Pediatrics

Learning Healthcare System to Improve Care and Outcomes of Children with Asthma

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My Career

- Training and working experience in Med-Peds

- Fellowship QI and Implementation/Dissemination Science

- Training in public health and medical informatics

- Multiple collaborations (translational, D&I, predictions, etc.)

- Biotechnology consulting

- Scientific reviewer (medical journals and grants)

Current Health Care System

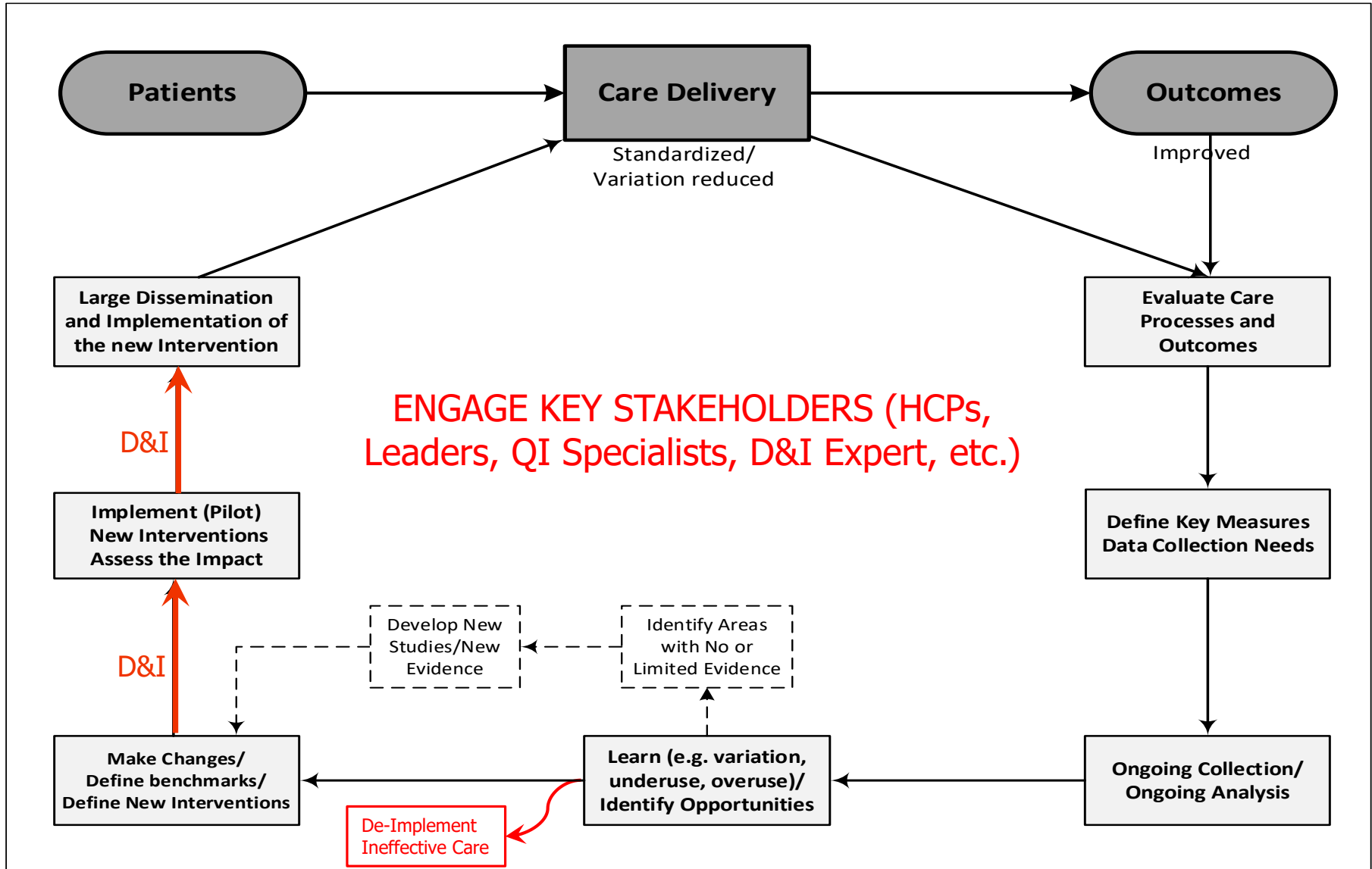FIGURE S-2 Schematic of the health care system today.

Persistent Gap in Evidence Translation

- Gap between publication and time findings are used in care

- Proliferation of new studies/impossible to stay up-to-date

- Many care decisions rely on gut feeling/personal biases

- Suboptimal care: underuse, overuse, unjustifiable variations

- Translation of research into practice remains challenging.

- LHS, an approach to facilitate evidence translation

LHS Vision

Patients → **Care Delivery** (Standardized/Variation reduced) → **Outcomes** (Improved)

ENGAGE KEY STAKEHOLDERS (HCPs, Leaders, QI Specialists, D&I Expert, etc.)

- Large Dissemination and Implementation of the new Intervention
- D&I
- Implement (Pilot) New Interventions Assess the Impact
- D&I
- Make Changes/ Define benchmarks/ Define New Interventions
- De-Implement Ineffective Care
- Develop New Studies/New Evidence
- Identify Areas with No or Limited Evidence
- Learn (e.g. variation, underuse, overuse)/ Identify Opportunities
- Ongoing Collection/ Ongoing Analysis
- Define Key Measures Data Collection Needs
- Evaluate Care Processes and Outcomes

Using LHS/Implementation and Dissemination Science to Improve Care of Children with Asthma

Children with Asthma Unmet Needs

- 8 million children <18 years with asthma (prevalence 13.8%)

- High exacerbations (up to 70%) and ED/hospital admissions

- 640,000 ED visits and 157,000 hospitalizations (2009)

- High readmissions (up to 50%, 12 months post discharge)

- Total costs of childhood asthma is 20.7 billion/year

- Decided to evaluate the inpatient asthma care

Inpatient Asthma Care Gaps (PCH 2005)

Measure	% compliance
Inpatient specific care measures	
1. Documented asthma acute severity assessment at the time of admission	38%
2. Use of systemic corticosteroid for all patients	100%
3. Use of oral (not IV) systemic corticosteroids	56%
4. Use of Ipratropium Bromide restricted to < 24 hrs after admission	24%
5. Use of albuterol delivered by MDI (not nebulized)	23%
Re-exacerbation/readmission prevention measures	
6. Documented chronic asthma severity assessment	19%
7. Parental participation in an asthma education class	39%
8. Written asthma action plan	5%
9. Scheduled follow-up appointment with the PCP at discharge	22%

Nkoy et al. Pediatrics 2008

Implementation of Inpatient Asthma CPM
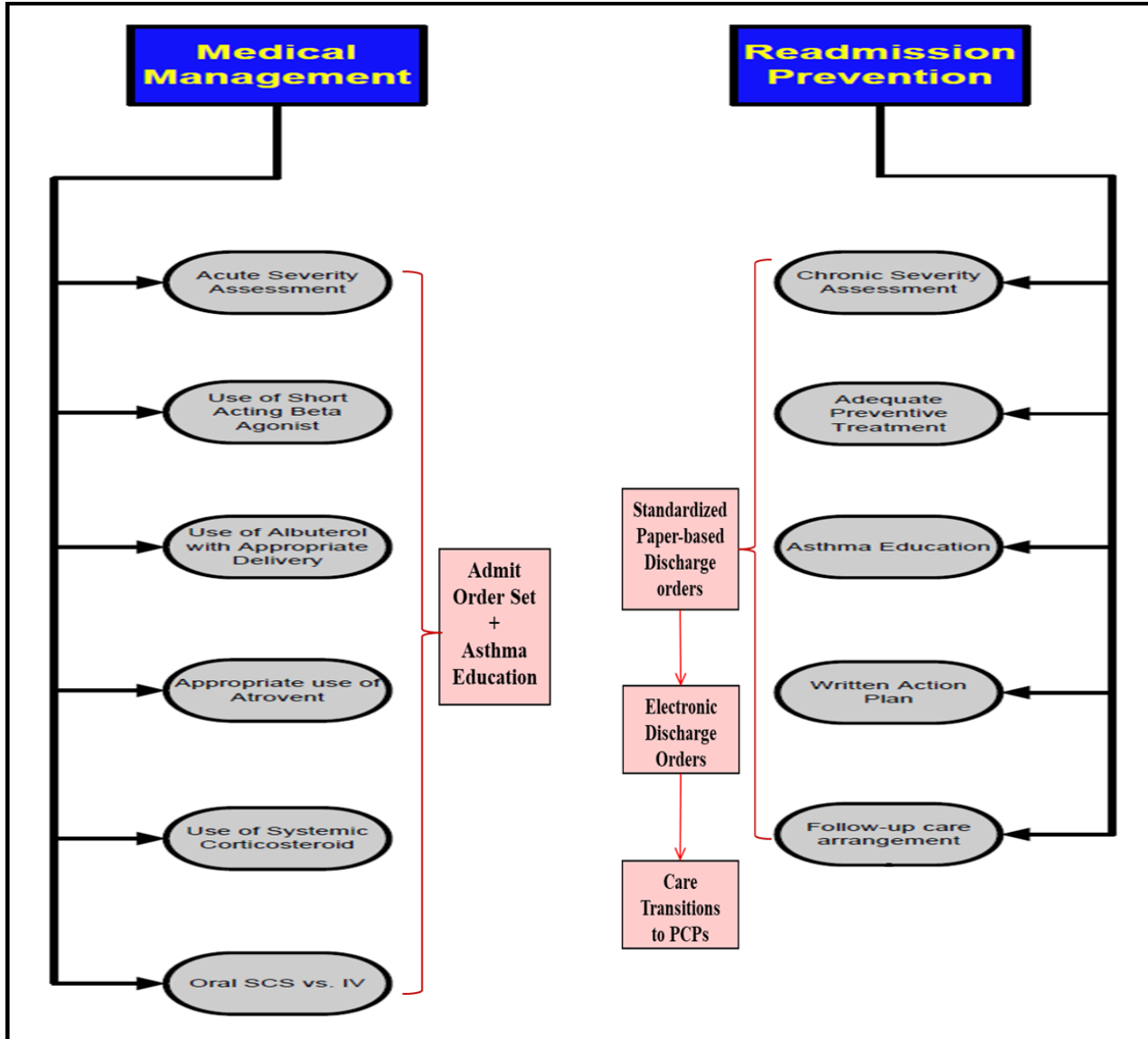
Implementation Strategies
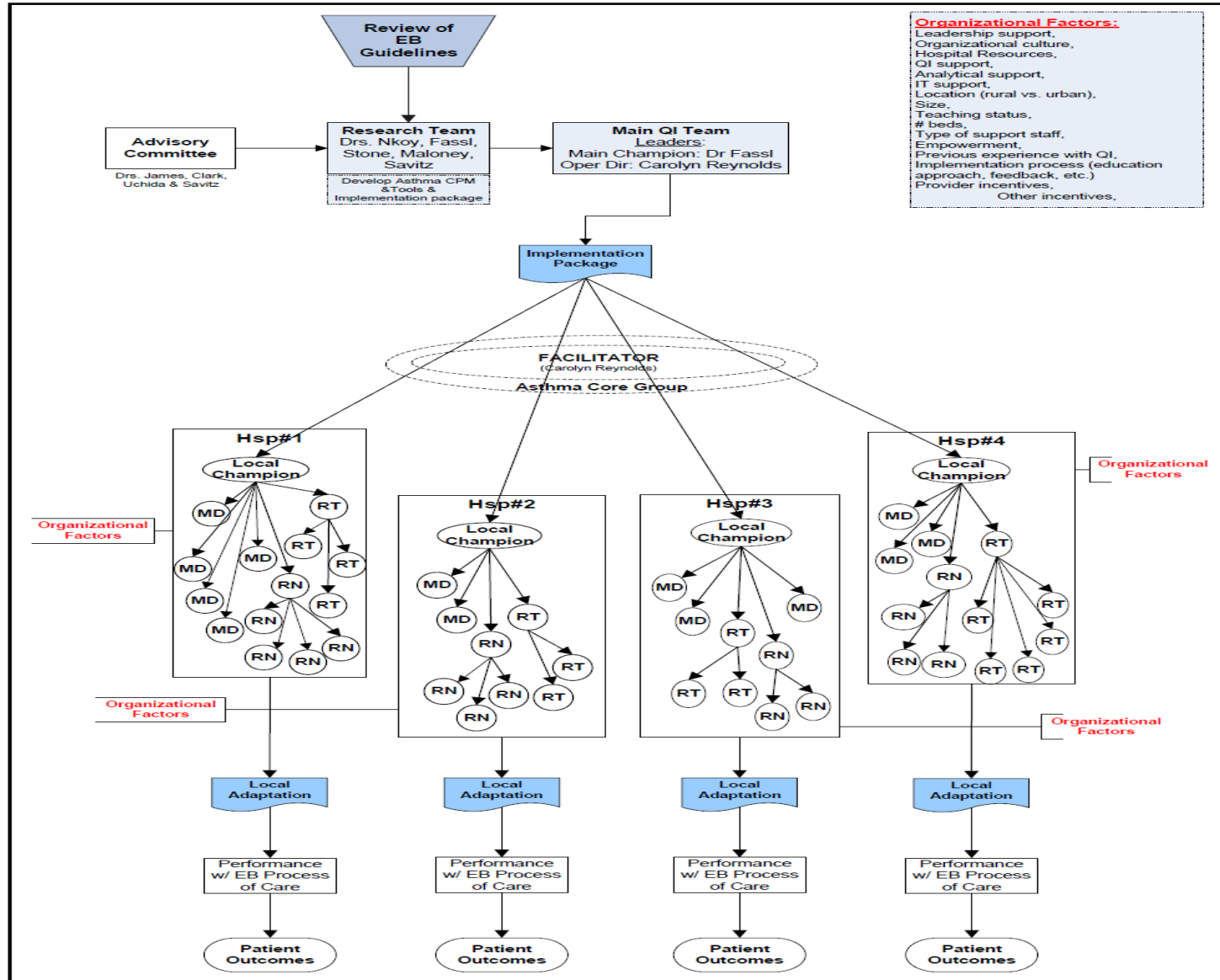
Inpatient Asthma Care (Composite Score)
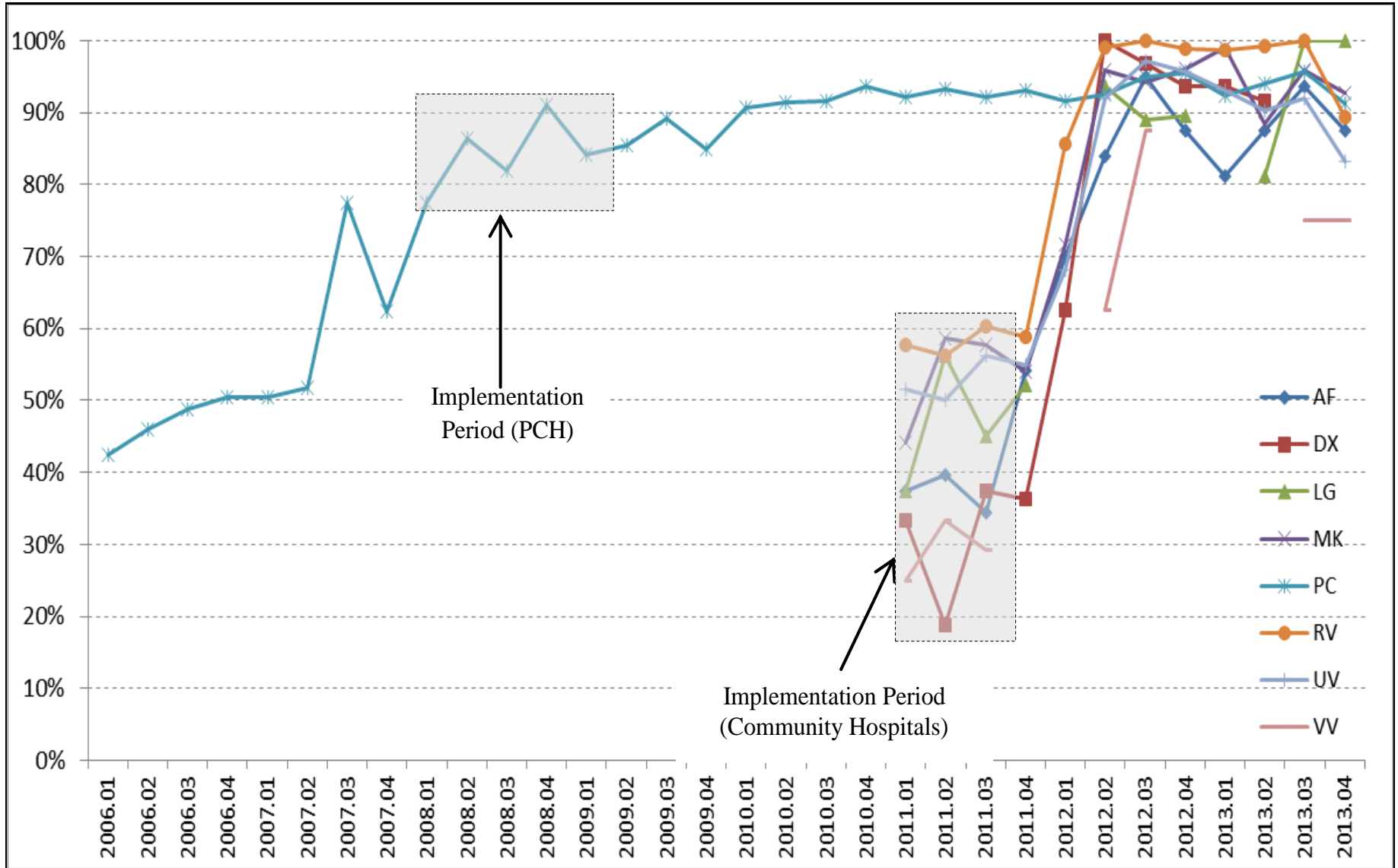
Impact on Inpatient Asthma Outcomes

Variable	Before Implementation	After Implementation	Odd Ratio or β	95% CI	p-value
Primary Children's Hospital					
6-mo readmission rate, % (SD)	16.4 (37.0)	13.6 (34.3)	0.81	0.67, 0.97	**0.026**
LOS, hrs, median (IQR)	49 (35-77)	45 (33-69)	-0.08	-0.13, -0.04	**< 0.001**
Hospitalization costs, adjusted for 2013 dollars, median (IQR)	1816.8 (1300.5-2614.2)	1703.6 (1144.9-2894.6)	-0.04	-0.08, 0.01	0.094
RRU, median (IQR)	22.6 (16.4-33.6)	22.6 (15.5-39.3)	0.03	-0.02, 0.07	0.218
Community Hospitals					
6-mo readmission rate, % (SD)	13.8 (34.5)	11.5 (31.9)	0.76	0.54, 1.07	0.119
LOS, hrs, median (IQR)	44 (33-59)	35 (24-48)	-0.24	-0.29, -0.18	**< 0.001**
Hospitalization costs, adjusted for 2013 dollars, median (IQR)	1556.9 (1157.4-2121.2)	1484.7 (1009.8-2066.3)	-0.05	-0.10, -0.001	**0.053**
RRU, median (IQR)	22.3 (16.9-29.8)	22.9 (16.8-31.7)	0.05	0.00, 0.10	**0.032**

Nkoy F, Fassl B, Stone B, Uchida DA, Johnson J, Reynolds C, Valentine K, Koopmeiners K, Kim EH, Savitz L, Maloney C. *Improving Pediatric Asthma Care and Outcomes Across Multiple Hospitals.* Pediatrics. 2015 Dec;136(6):e1602-10.

Contextual Factors Associated with Success

Contextual Factors Influencing Implementation of Evidence-Based Care for Children Hospitalized With Asthma

Flory L. Nkoy, MD, MS, MPH,[a] Victoria L. Wilkins, MD, MPH,[a] Bernhard A. Fassl, MD,[a] Joseph M. Johnson, MD,[b] Derek A. Uchida, MD,[a] Justin B. Poll, PhD,[b] Tom H. Greene, PhD,[a] Karmella J. Koopmeiners, RN, MS,[b] Carolyn C. Reynolds, RN, MS,[b] Karen J. Valentine, MStat,[b] Lucy A. Savitz, PhD,[b] Christopher G. Maloney, MD, PhD,[c] Bryan L. Stone, MD, MS[a]

ABSTRACT

BACKGROUND AND OBJECTIVES: The translation of research findings into routine care remains slow and challenging. We previously reported successful implementation of an asthma evidence-based care process model (EB-CPM) at 8 (1 tertiary care and 7 community) hospitals, leading to a high health care provider (HCP) adherence with the EB-CPM and improved outcomes. In this study, we explore contextual factors perceived by HCPs to facilitate successful EB-CPM implementation.

METHODS: Structured and open-ended questions were used to survey HCPs ($n = 260$) including physicians, nurses, and respiratory therapists, about contextual factors perceived to facilitate EB-CPM implementation. Quantitative analysis was used to identify significant factors (correlation coefficient ≥ 0.5; $P \leq .05$) and qualitative analysis to assess additional facilitators.

RESULTS: Factors perceived by HCPs to facilitate EB-CPM implementation were related to (1) inner setting (leadership support, adequate resources, communication and/or collaboration, culture, and previous experience with guideline implementation), (2) intervention characteristics (relevant and applicable to the HCP's practice), (3) individuals (HCPs) targeted (agreement with the EB-CPM and knowledge of supporting evidence), and (4) implementation process (participation of HCPs in implementation activities, teamwork, implementation team with a mix of expertise and professional's input, and data feedback). Additional facilitators included (1) having appropriate preparation and (2) providing education and training.

CONCLUSIONS: Multiple factors were associated with successful EB-CPM implementation and may be used by others as a guide to facilitate implementation and dissemination of evidence-based interventions for pediatric asthma and other chronic diseases in the hospital setting.

Missed Opportunities
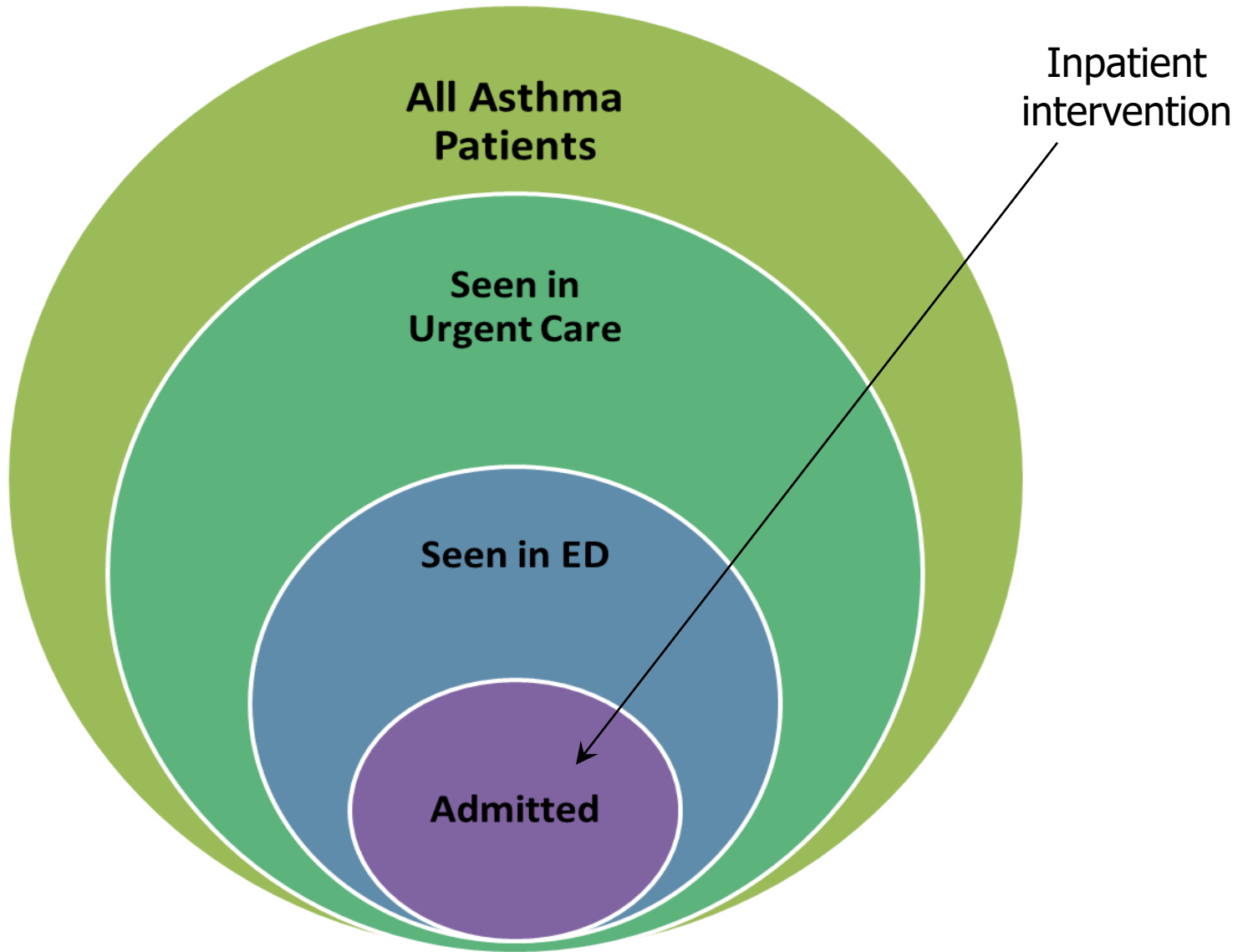
Suboptimal Ambulatory Asthma Control

- 68% children not well controlled (*Carlton 2005*)

- 59% uncontrolled asthma (*Chapman 2008*)

- 56% poorly controlled asthma (*Bloomberg 2009*)

- 75% not well controlled asthma (*2011 ED visits at PCH*)

- Inconsistency between patients' perceptions and NIH criteria: 71% vs. 29% (*Murphy 2012*)

- Other studies showed up to 75% suboptimal asthma control (*Azaldegi 2019; Guilbert 2019, Koshis 2019, Sullivan 2019*)

Children with Asthma Unmet Needs

Uncontrolled Asthma

Effective approaches are needed to improve ambulatory asthma control and prevent exacerbations

Asthma Exacerbations
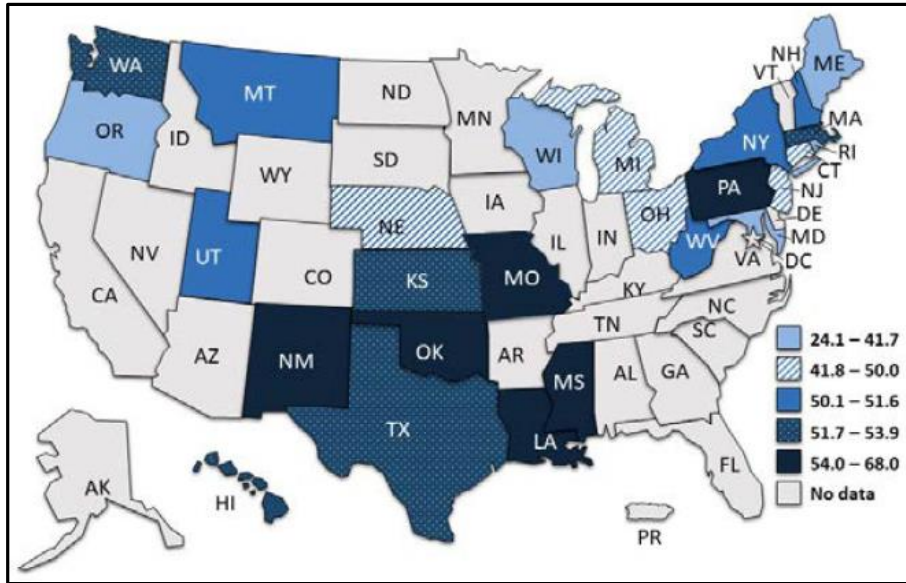
Source:
CDC. AsthmaStats. Uncontrolled Asthma among Children, 2012–2014
https://www.cdc.gov/asthma/asthma_stats/uncontrolled-asthma-children.htm

CDC. Asthma Attacks among People with Current Asthma, 2014–2017 https://www.cdc.gov/asthma/asthma_stats/attacks-current-asthma.htm
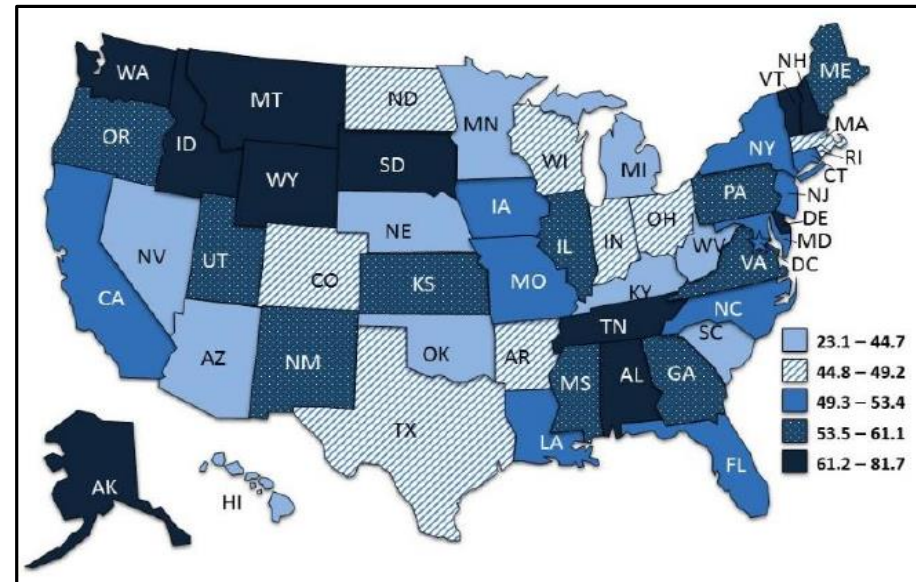
GOAL study (Bateman et al, 2007)
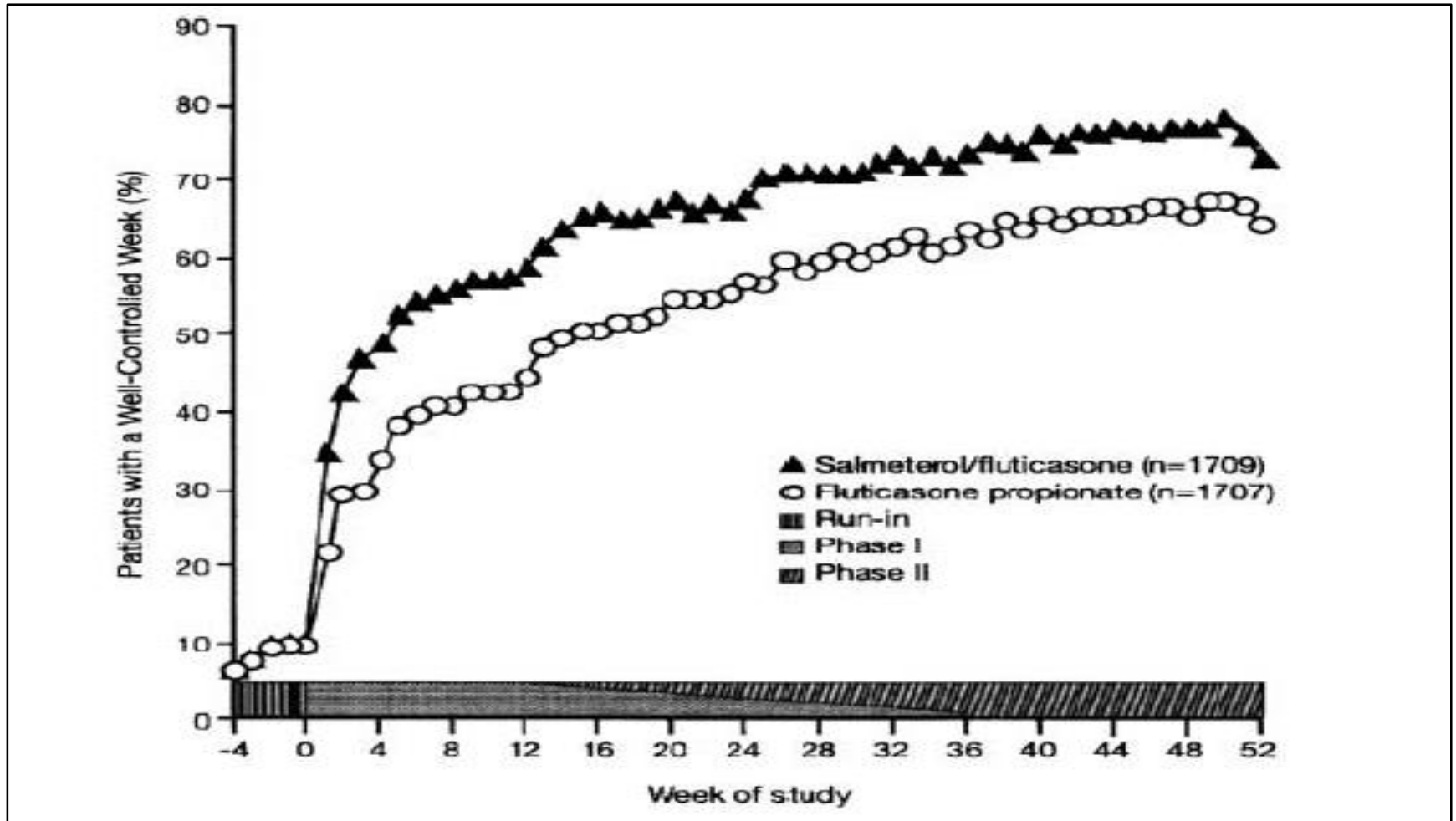
Frequent assessments of asthma control and timely intervention can improve and sustain optimal asthma control

Challenges to Implement Ongoing Monitoring

- Current care model not designed for ongoing monitoring

- HCPs lack tools and resources to monitor patients outside clinical encounters

- Lack of incentive and payment model

- Lack effective tools for families

- Current ambulatory asthma care model is reactive

Current Ambulatory Care Delivery
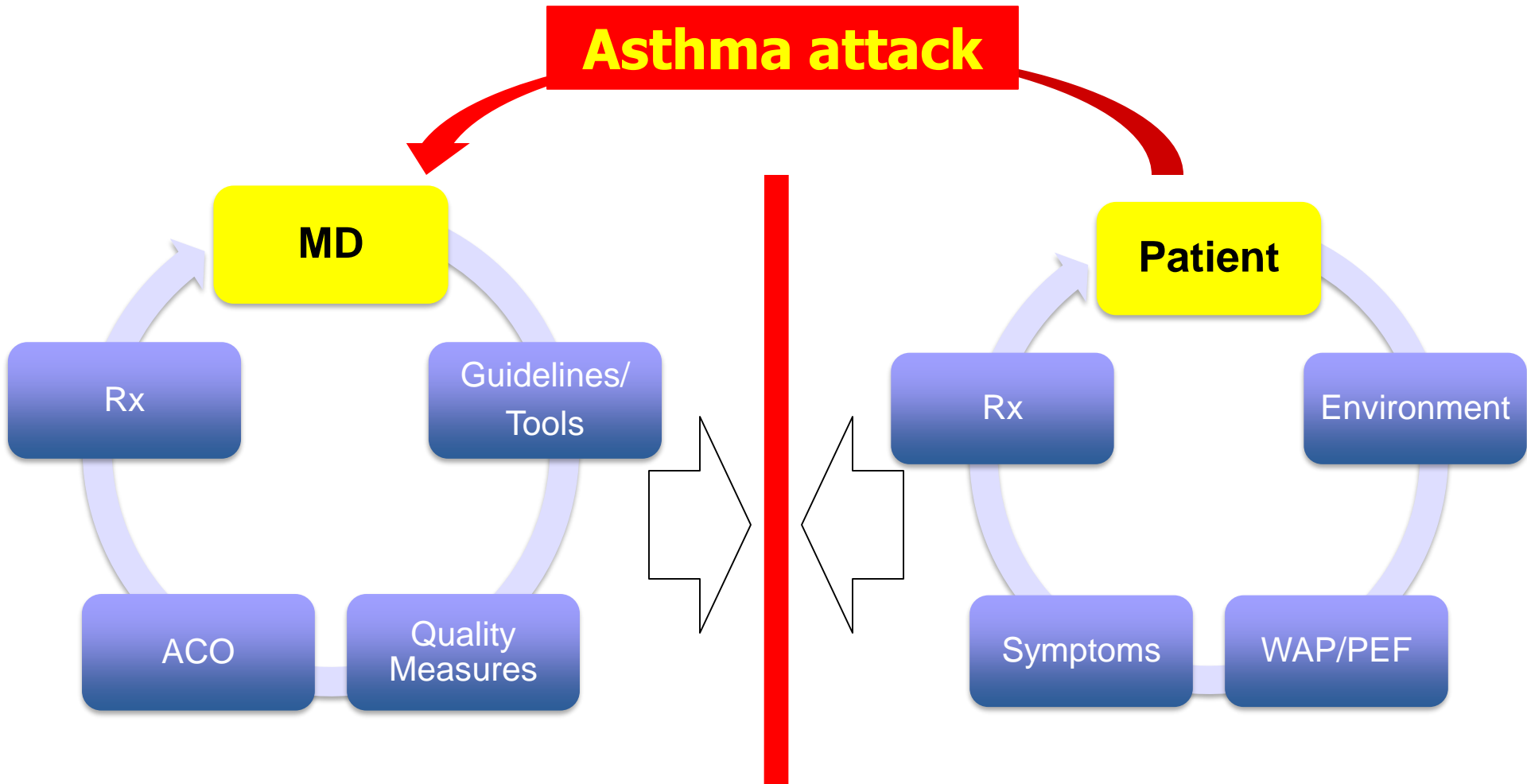
Redesigning Ambulatory Asthma Care

- Implement a **continuous** and **proactive** care model

- Engage parents in home monitoring of their child's asthma

- Empower parents to recognize/act on early deterioration signs

- Provide real-time, objective data and alerts to HCPs

- Support HCPs to make appropriate, timely medical decisions

- Improve/maintain asthma control and reduce exacerbations

Shifting the LHS Model to Patients
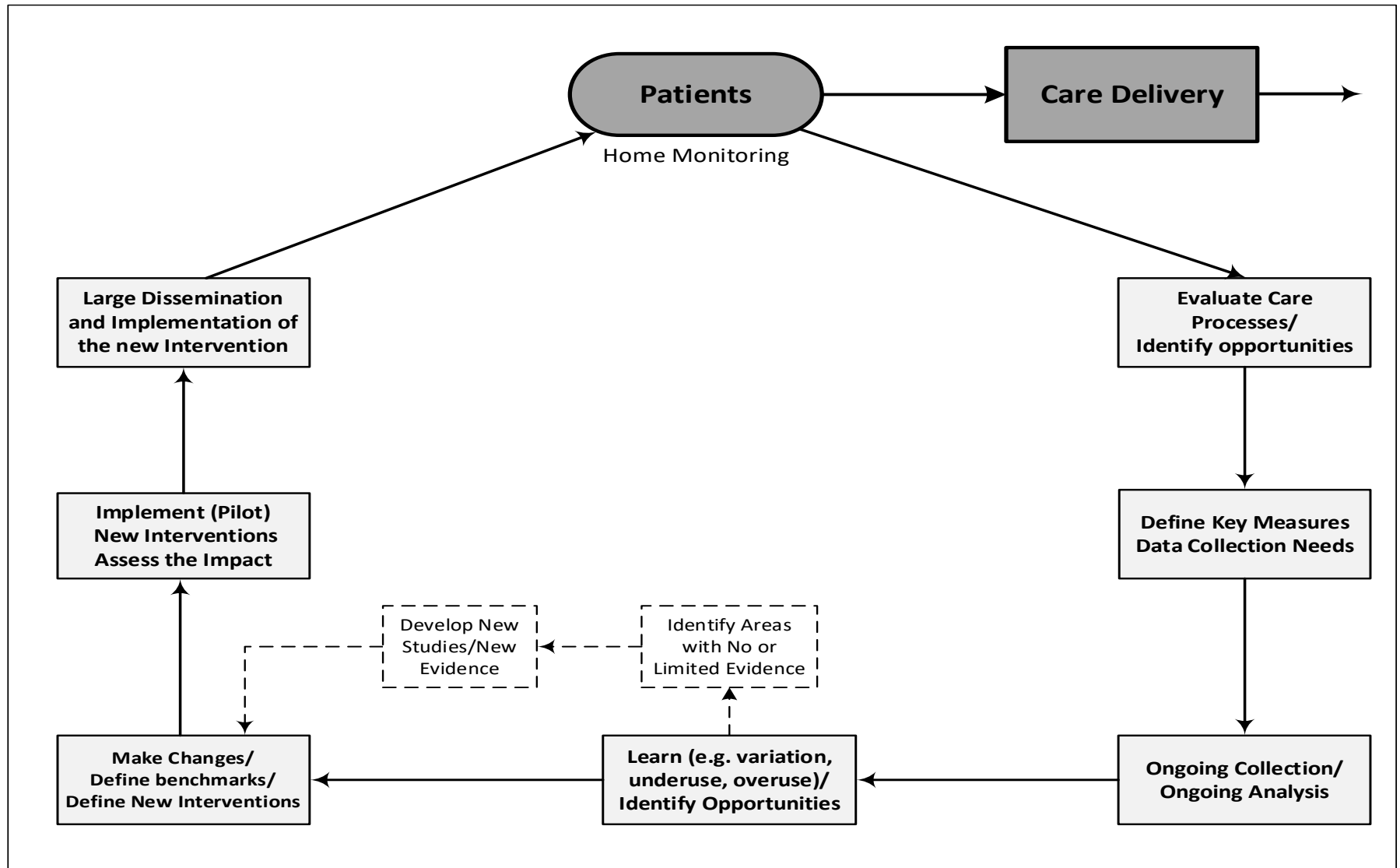
Asthma Control Test (ACT)

Asthma Control Test™

This survey was designed to help you describe your asthma and how your asthma affects how you feel and what you are able to do. To complete it, please mark an ⊠ in the one box that best describes your answer.
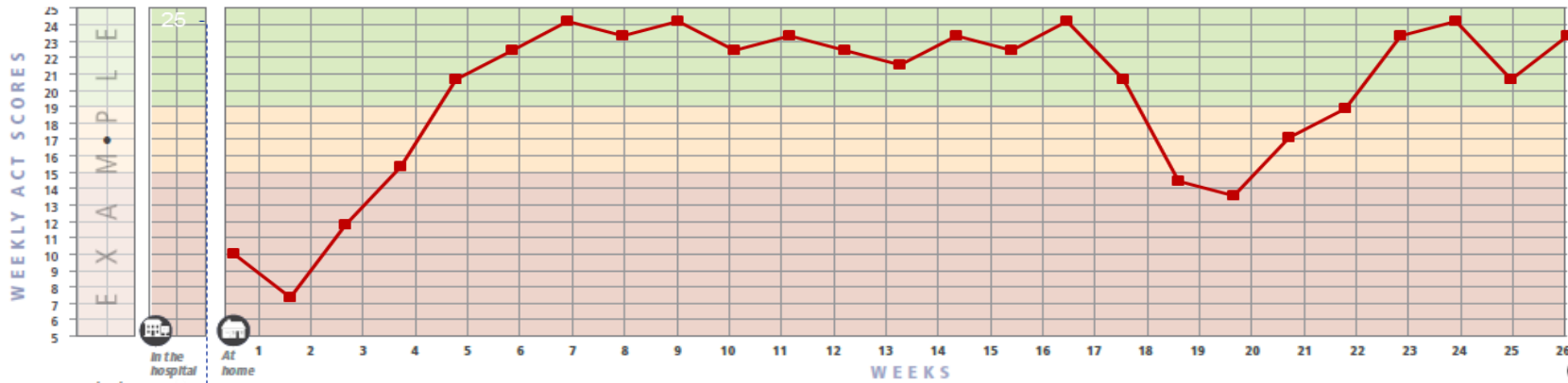
1. In the past 4 weeks, how much of the time did your asthma keep you from getting as much done at work, school or at home?

All of the time	Most of the time	Some of the time	A little of the time	None of the time
☐1	☐2	☐3	☐4	☐5

2. During the past 4 weeks, how often have you had shortness of breath?

More than once a day	Once a day	3 to 6 times a week	Once or twice a week	Not at all
☐1	☐2	☐3	☐4	☐5

3. During the past 4 weeks, how often did your asthma symptoms (wheezing, coughing, shortness of breath, chest tightness or pain) wake you up at night or earlier than usual in the morning?

4 or more nights a week	2 to 3 nights a week	Once a week	Once or Twice	Not at all
☐1	☐2	☐3	☐4	☐5

4. During the past 4 weeks, how often have you used your rescue inhaler or nebulizer medication (such as Albuterol, Ventolin®, Proventil®, Maxair® or Primatene Mist®)?

3 or more times per day	1 or 2 times per day	2 or 3 times per week	Once a week or less	Not at all
☐1	☐2	☐3	☐4	☐5

5. How would you rate your asthma control during the past 4 weeks?

Not Controlled at all	Poorly Controlled	Somewhat Controlled	Well Controlled	Completely Controlled
☐1	☐2	☐3	☐4	☐5

Asthma Symptom Tracker

Reliability and Validity of Asthma Tracker

Longitudinal Validation of a Tool for Asthma Self-Monitoring

WHAT'S KNOWN ON THIS SUBJECT: To prevent asthma exacerbations, asthma guidelines recommend ongoing monitoring of patients' asthma symptoms to promote timely adjustments of therapy to achieve and maintain optimal control. Existing tools, validated for ongoing monitoring, have significant limitations in children.

WHAT THIS STUDY ADDS: Our study established longitudinal validation of the Asthma Symptom Tracker, a novel tool designed for use by children or their parents to facilitate ongoing monitoring of patients' asthma symptoms and proactive medical decision-making to prevent acute exacerbations.

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abstract

OBJECTIVES: To establish longitudinal validation of a new tool, the Asthma Symptom Tracker (AST). AST combines weekly use of the Asthma Control Test with a color-coded graph for visual trending.

METHODS: Prospective cohort study of children age 2 to 18 years admitted for asthma. Parents or children ($n = 210$) completed baseline AST assessments during hospitalization, then over 6 months after discharge. Concurrent with the first 5 AST assessments, the Asthma Control Questionnaire (ACQ) was administered for comparison.

RESULTS: Test–retest reliability (intraclass correlation) was moderate, with a small longitudinal variation of AST measurements within subjects during follow-ups. Internal consistency was strong at baseline (Cronbach's α 0.70) and during follow-ups (Cronbach's α 0.82–0.90). Criterion validity demonstrated a significant correlation between AST and ACQ scores at baseline ($r = -0.80$, $P < .01$) and during follow-ups ($r = -0.64$, -0.72, -0.63, and -0.69). The AST was responsive to change over time; an increased ACQ score by 1 point was associated with a decreased AST score by 2.65 points ($P < .01$) at baseline and 3.11 points ($P < .01$) during follow-ups. Discriminant validity demonstrated a strong association between decreased AST scores and increased oral corticosteroid use (odds ratio 1.13, 95% confidence interval, 1.10–1.16, $P < .01$) and increased unscheduled acute asthma visits (odds ratio 1.23, 95% confidence interval, 1.18–1.28, $P < .01$).

CONCLUSIONS: The AST is reliable, valid, and responsive to change over time, and can facilitate ongoing monitoring of asthma control and proactive medical decision-making in children. *Pediatrics* 2013;132:e1554—e1561

Impact (Pilot Implementation)

Time to First (ED/hospital) Readmission (adjusted for age and race)

Stakeholder Engagement

- Development of the paper-AsthmaTracker
  - Focus groups (5 parents and 2 teenagers)
  - Healthcare organization leaders

- Development and usability test of the electronic-AsthmaTracker (e-AT)
  - 10 parents and 4 teenagers
  - Healthcare organization leaders

- Implementation of the e-AT in 11 clinics
  - Parents, teenagers, PCPs, other community stakeholders.
  - Payers, UDOH, Healthcare organization leaders

- Broad dissemination and implementation of the e-AT
  - Parents, teenagers, PCPs, other community stakeholders.
  - Payers, UDOH, Healthcare organization/community leaders

Electronic-AsthmaTracker (e-AT)
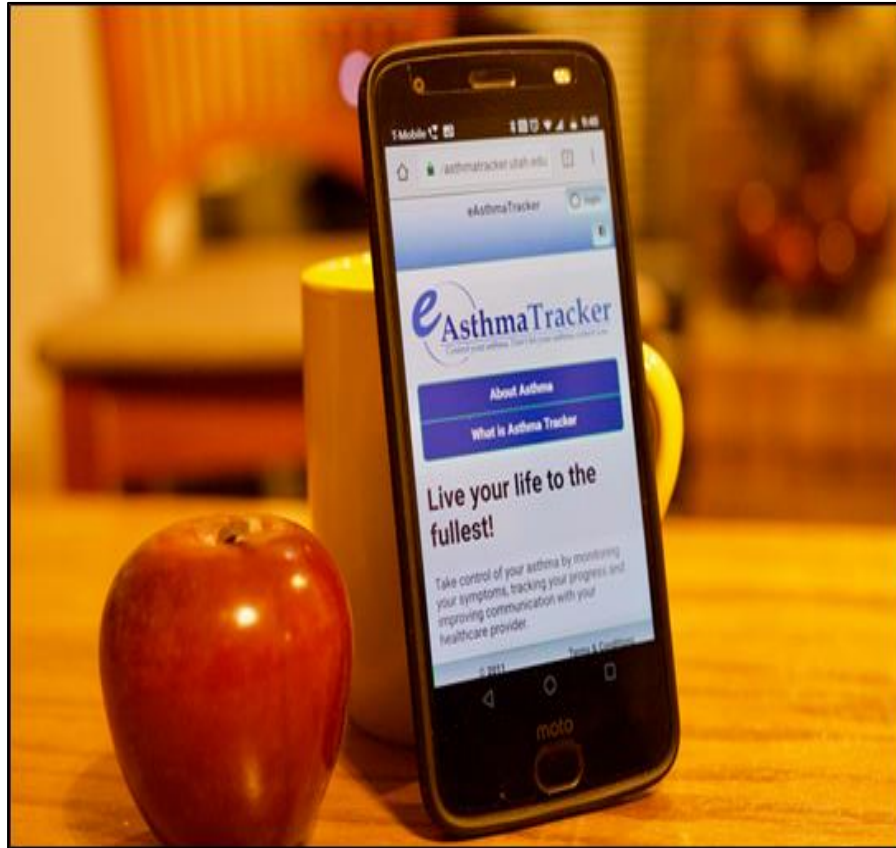
- ➢ Validated asthma control measurement
- ➢ Automated reminders to use weekly
- ➢ Immediate recommendation and graphic feedback to patients/parents
- ➢ Real-time alerting to patients/parents and their PCPs
- ➢ Available in English and Spanish
- ➢ Clinic dashboard for PCPs to manage asthma population

Weekly Asthma Control Assessment

eAsthmaTracker
Control your asthma. Don't let your asthma control you.

Instructions | Complete Asthma Test | View Graph | Print Graph | Education Resources | Profile | Logout

During the **PAST WEEK**:

How much of the time did your asthma keep you from getting as much done at home, school, or work?

○ 1. All of the time ○ 2. Most of the time ○ 3. Some of the time ○ 4. A little of the time ○ 5. None of the time

How often have you had shortness of breath?

○ 1. More than once a day ○ 2. Once a day ○ 3. Three to six times ○ 4. Once or twice ○ 5. Not at all

How often did your asthma symptoms (wheezing, coughing, shortness of breath, chest tightness or pain) wake you up at night or earlier than usual in the morning?

○ 1. Four or more nights ○ 2. Three nights ○ 3. Two nights ○ 4. A little of the time ○ 5. None of the time

How often have you used your quick-relief inhaler or nebulizer medication (such as albuterol, Ventolin®, Proventil®, or Maxair®)?

○ 1. Three or more times per day ○ 2. One or two times per day ○ 3. Two or three times during the week ○ 4. Once this week ○ 5. Not at all
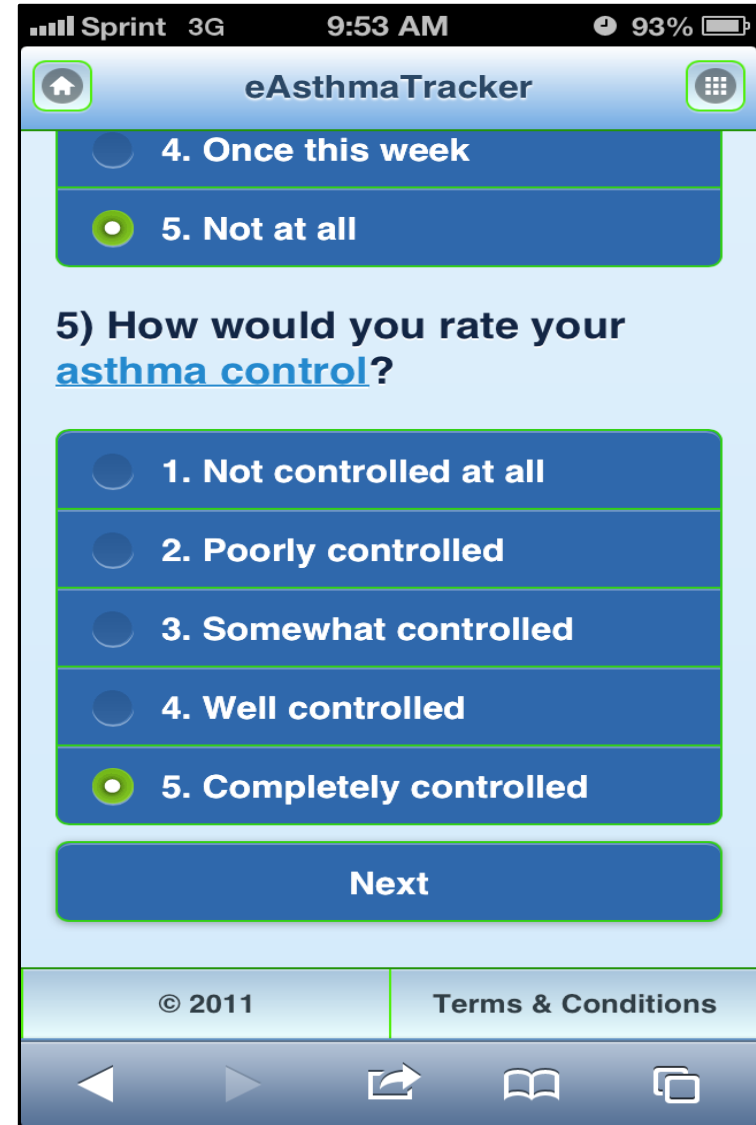
How would you rate your asthma control?

○ 1. Not controlled at all ○ 2. Poorly controlled ○ 3. Somewhat controlled ○ 4. Well controlled ○ 5. Completely controlled

Next

e-Asthma Tracker (Mobile Web Version)

Current Therapy and Compliance

Real-time Recommendations

Motivational Features

Longitudinal View

Real eAsthma Tracker Patient Graph

Understanding Patient's Symptoms

Adding and stepping up controller medications

Understanding Patient's Symptoms

gave the cat away to neighbors on Sunday, since then asthma has improved a lot

Close

Identifying Triggers
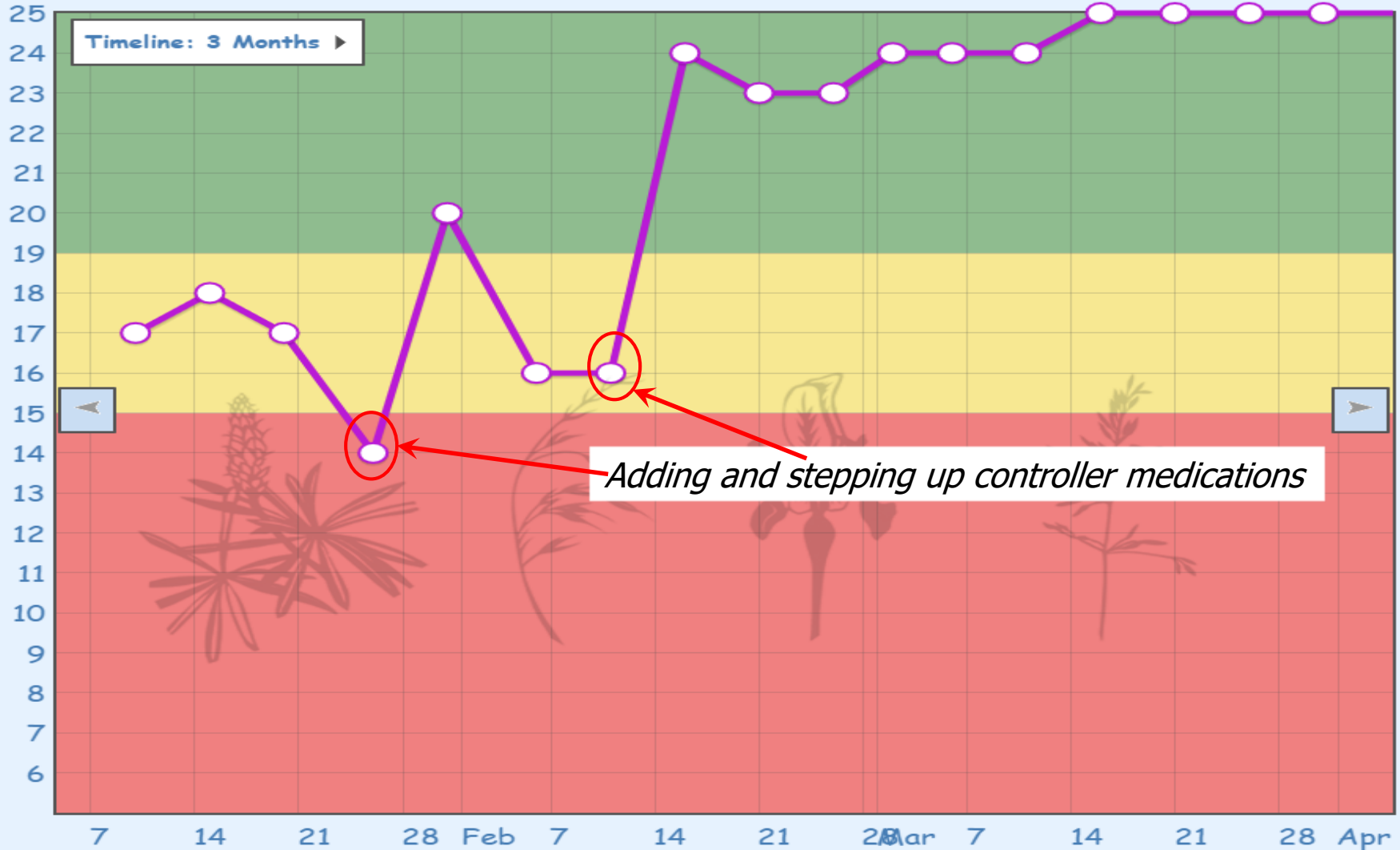
Timeline: 3 Months ▶
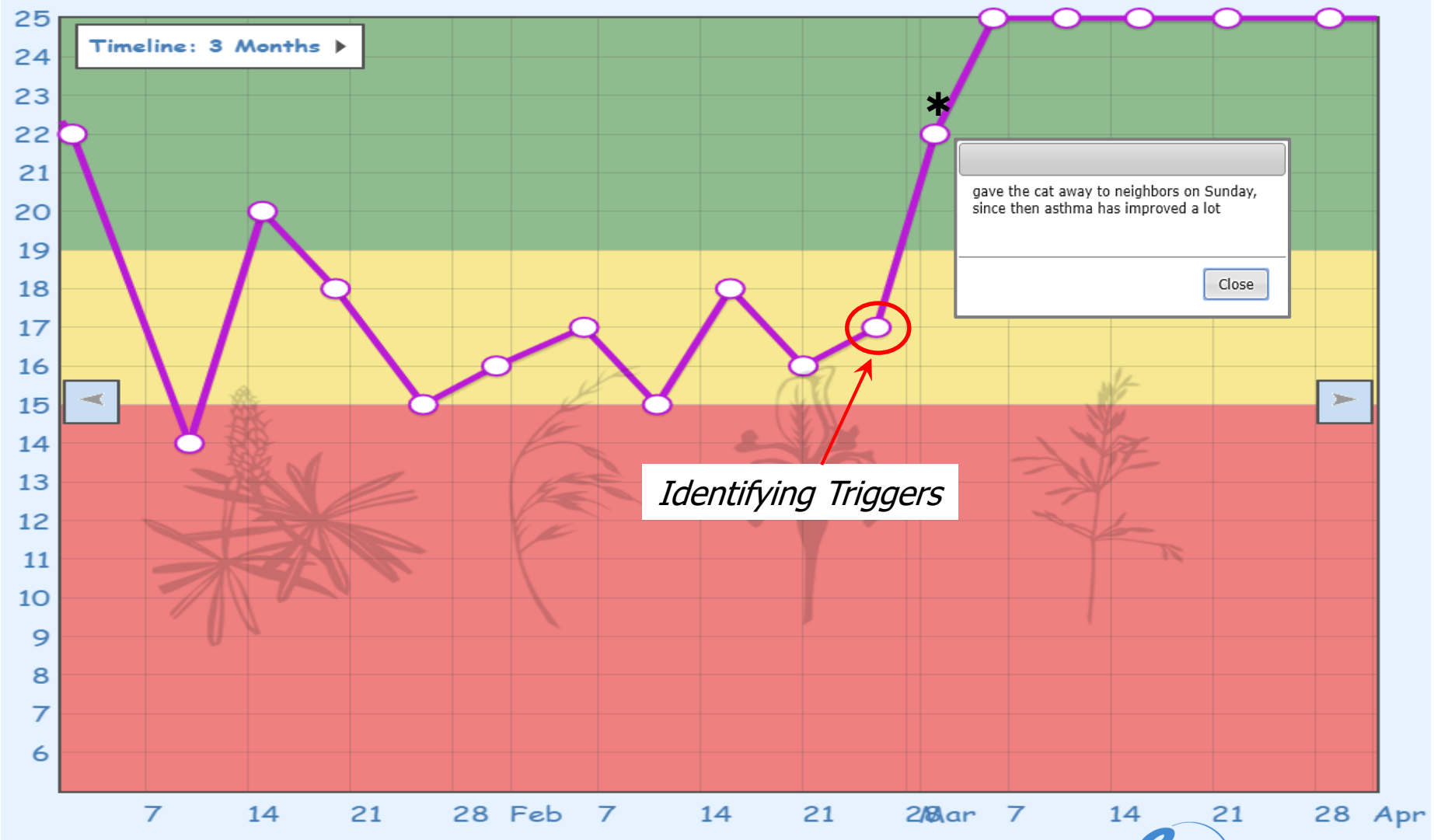
Involving Clinics (Dashboard)

A New Ambulatory Asthma Care Model

E-Asthma Tracker

Frequent assessments of asthma symptoms

MD

Patient

Asthma attack

Guidelines

Rx

Rx

Environment

Ongoing communication

ACO

Quality Measures

Symptoms

WAP

e-AT Implementation in 11 Ambulatory Care Clinics

Study Funded by PCORI

Approach (Clinics)

- Cluster randomization of clinics

- Trained clinics to deliver the e-AT to their patients

- Engaged clinic champions

- Provided facilitation and ongoing support

- Care coordinators monitored patients using the dashboard

- Clinics received alerts to follow-up patients with issues

Approach (Patients/Parents)

- Children 2-17 with persistent asthma were identified at each clinic and invited to participate by clinic coordinators

- Consented, and received training and access to the e-AT

- Enrolled from January 2014 to December 2015

- Used the e-AT weekly for 1 year and received automated reminders and alerts.

- Received incentive (gift cards) and technical support

Time in the Study
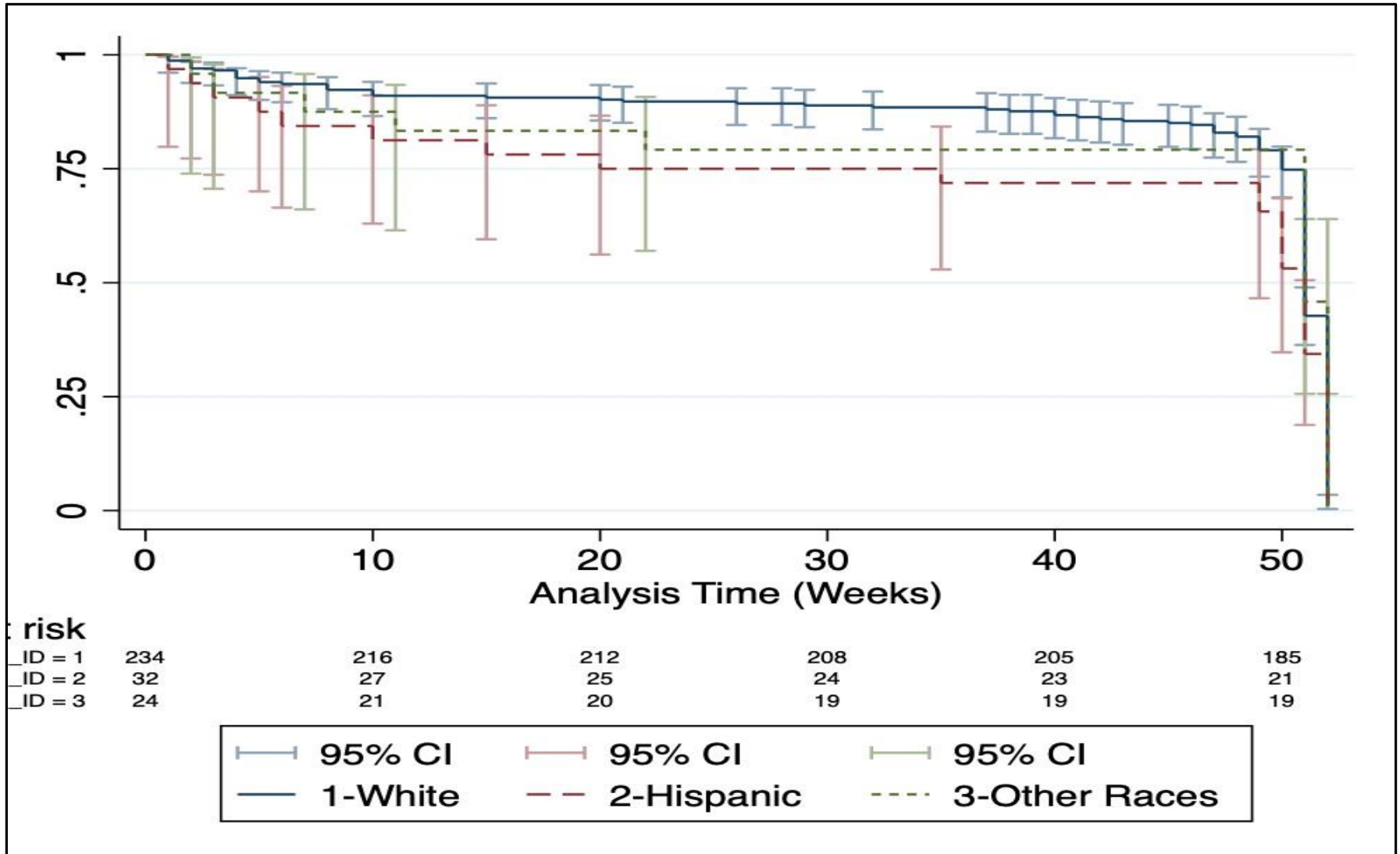
Patient QOL Scores
(Baseline, 3, 6, and 12 months)

Asthma Control Scores
(Baseline, Q1, Q2, Q3, and Q4)

Missed School and Work Days
(3, 6 and 12 months)

Interrupted/Missed School Days

Interrupted/Missed Work Days

ED/Hospital Admissions and OCS use
(One Year Pre-vs Post- Intervention)

ED/Hospital Admissions

Oral Corticosteroid (OCS) Use

Results of e-AT Implementation
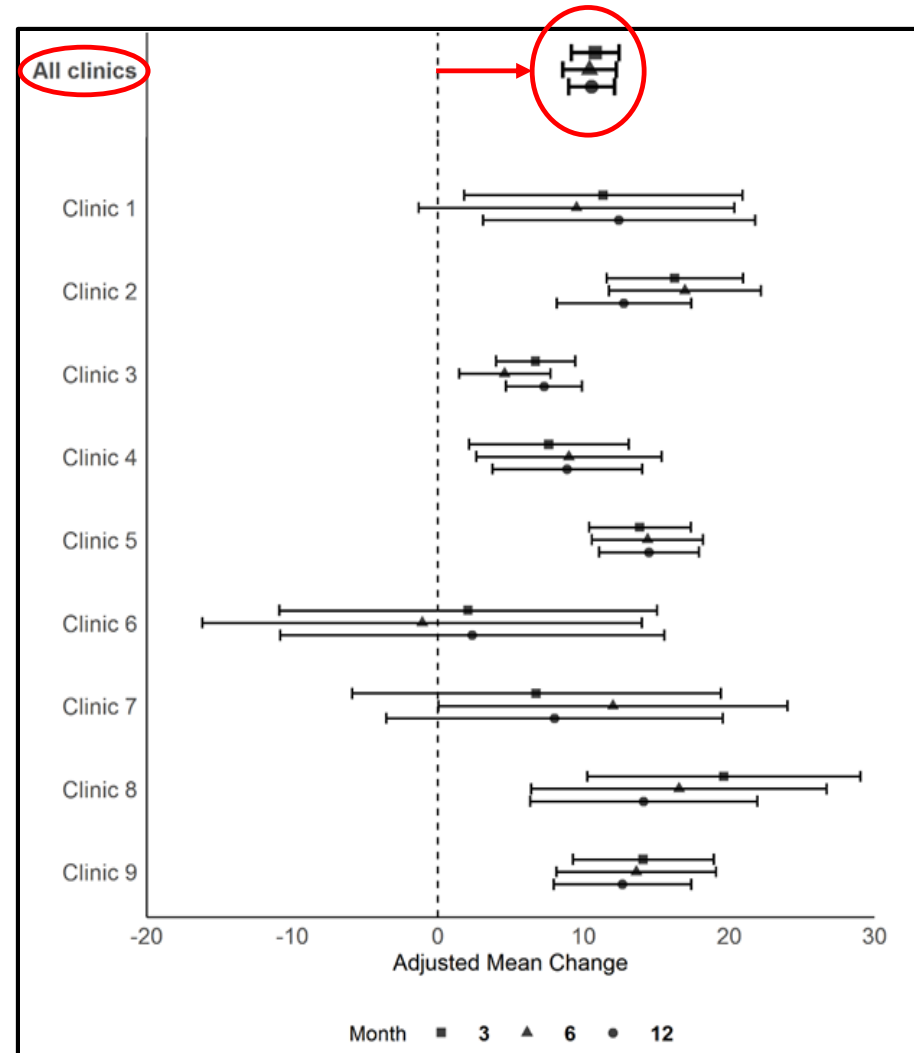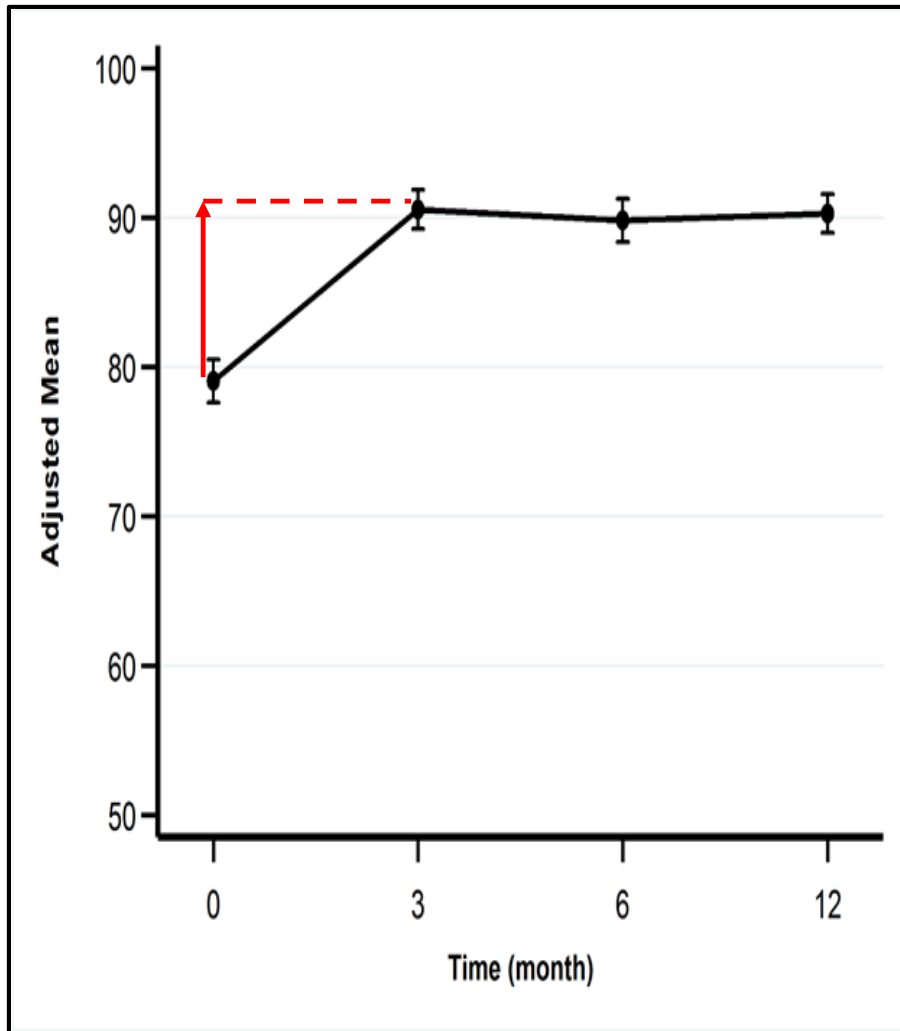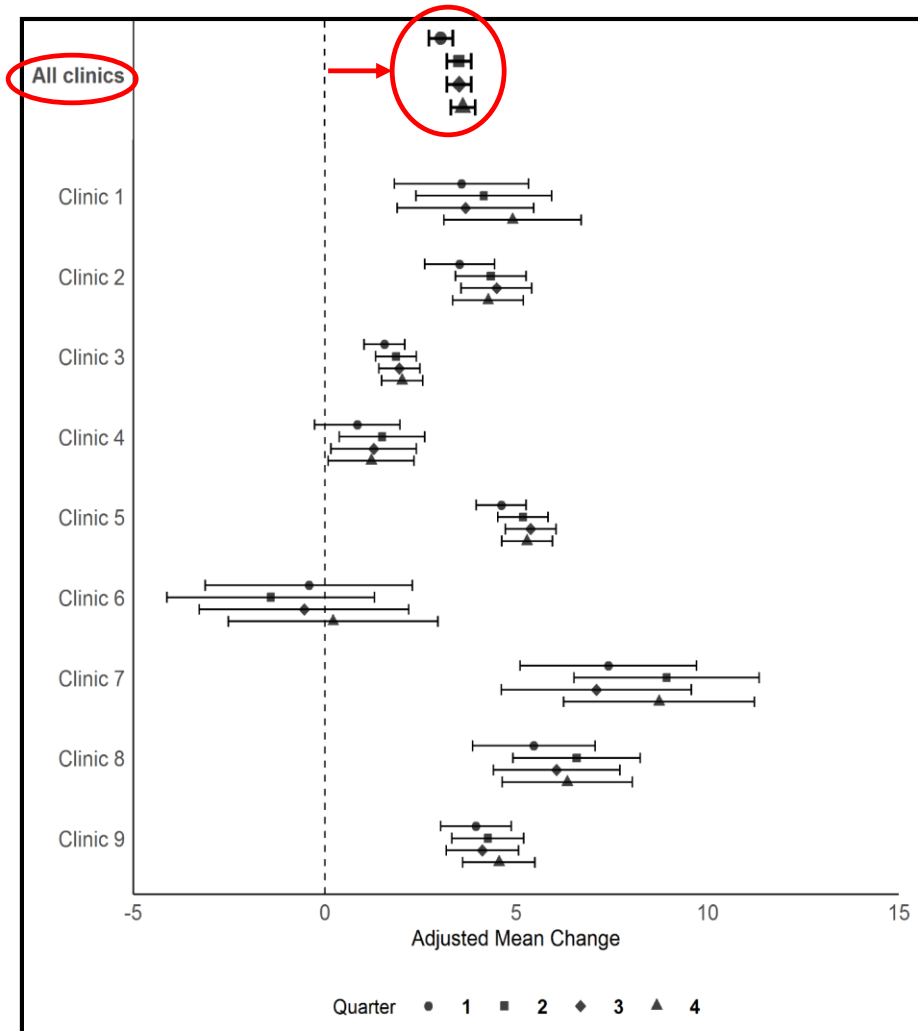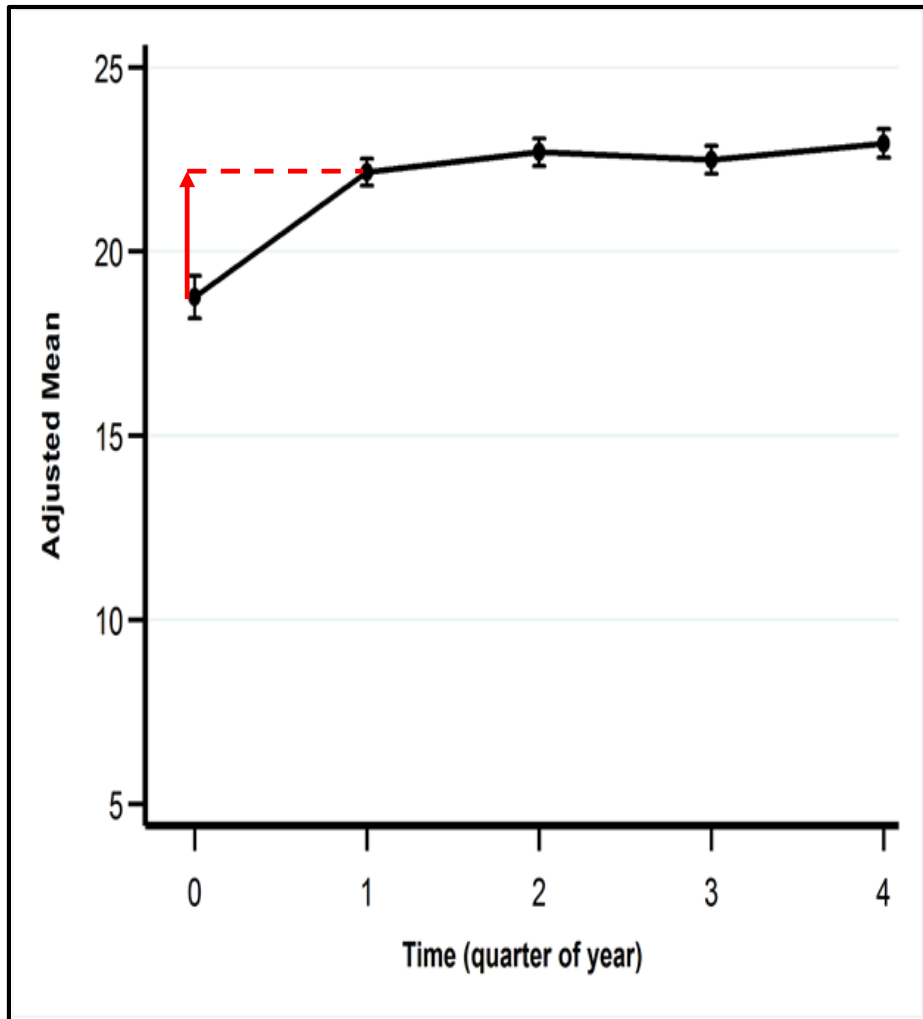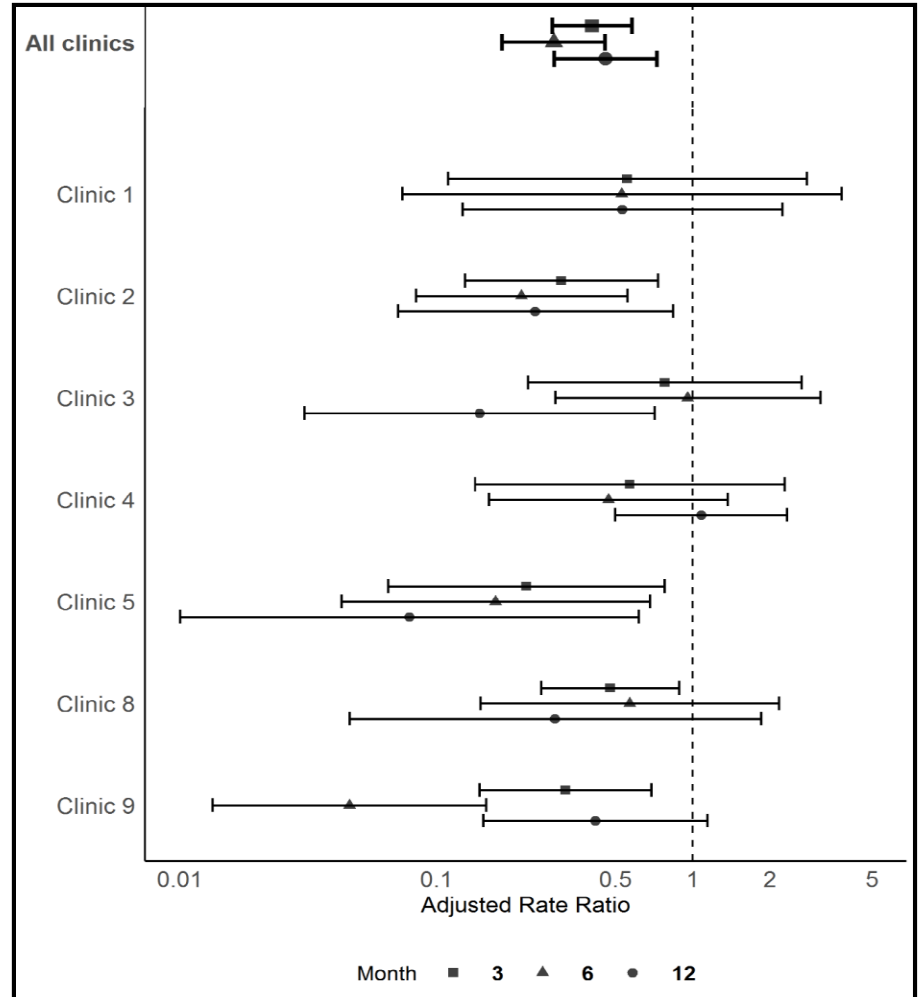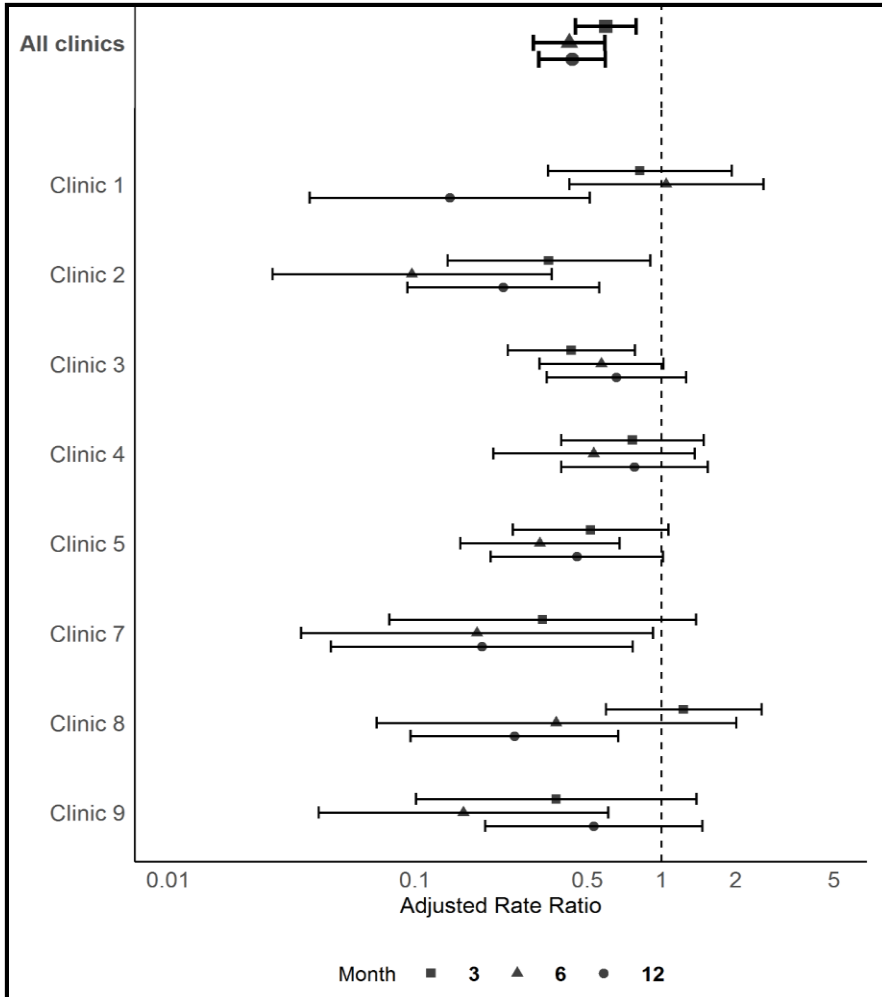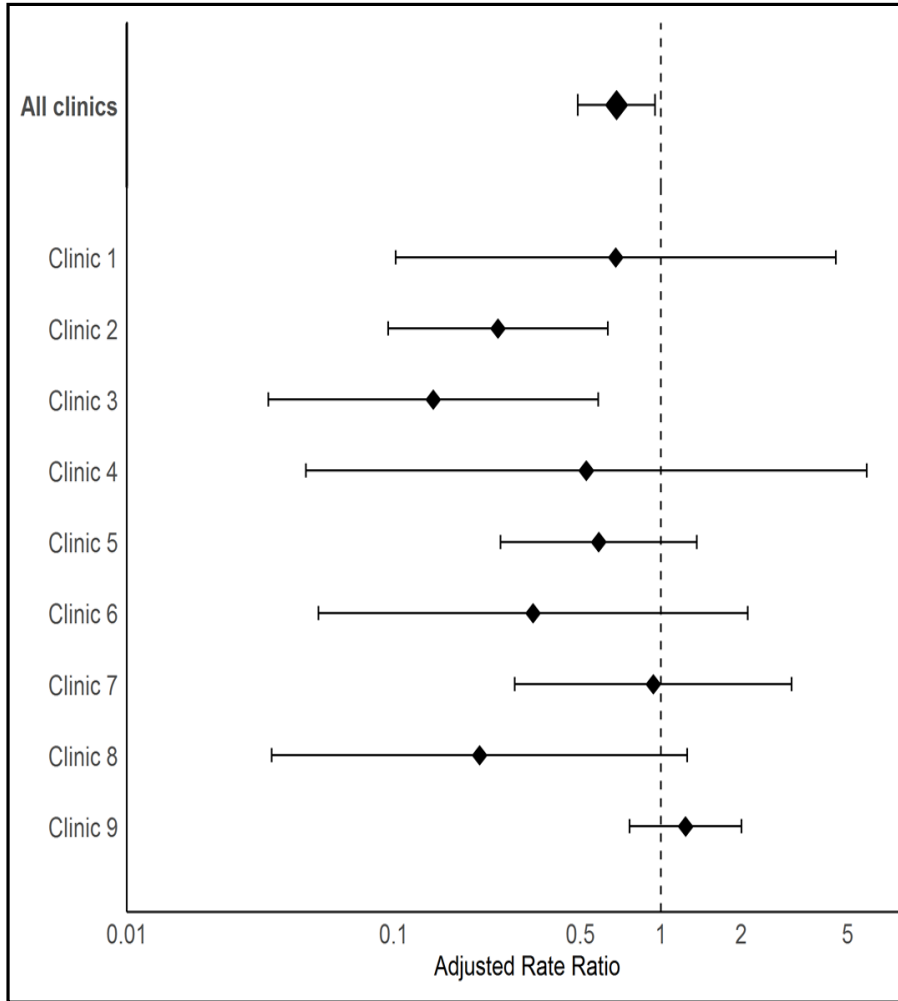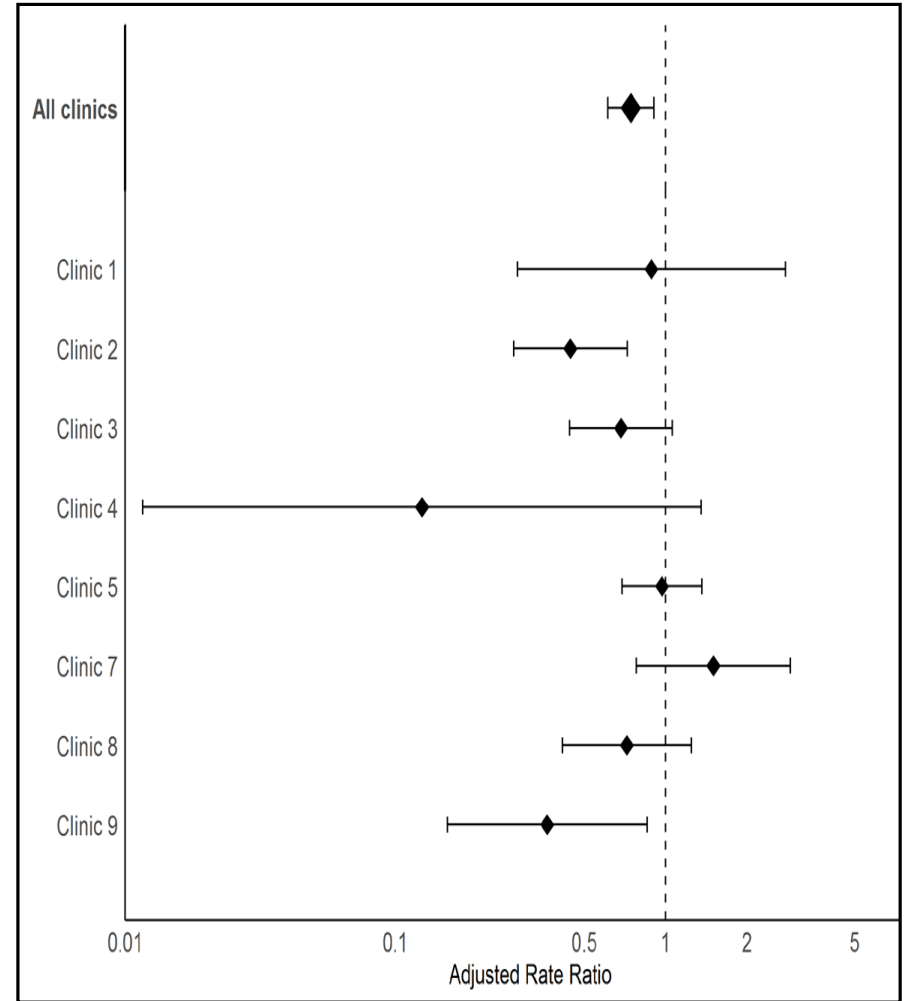
Ambulatory Management of Childhood Asthma Using a Novel Self-management Application

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BACKGROUND AND OBJECTIVES: Pediatric ambulatory asthma control is suboptimal, reducing quality of life (QoL) and causing emergency department (ED) and hospital admissions. We assessed the impact of the electronic-AsthmaTracker (e-AT), a self-monitoring application for children with asthma.

METHODS: Prospective cohort study with matched controls. Participants were enrolled January 2014 to December 2015 in 11 pediatric clinics for weekly e-AT use for 1 year. Analyses included: (1) longitudinal changes for the child (QoL, asthma control, and interrupted and missed school days) and parents (interrupted and missed work days and satisfaction), (2) comparing ED and hospital admissions and oral corticosteroid (OCS) use pre- and postintervention, and (3) comparing ED and hospital admissions and OCS use between e-AT users and matched controls.

RESULTS: A total of 327 children and parents enrolled; e-AT adherence at 12 months was 65%. Compared with baseline, participants had significantly ($P < .001$) increased QoL, asthma control, and reduced interrupted and missed school and work days at all assessment times. Compared with 1 year preintervention, they had reduced ED and hospital admissions (rate ratio [RR]: 0.68; 95% confidence interval [CI]: 0.49–0.95) and OCS use (RR: 0.74; 95% CI: 0.61–0.91). Parent satisfaction remained high. Compared with matched controls, participants had reduced ED and hospital admissions (RR: 0.41; 95% CI: 0.22–0.75) and OCS use (RR: 0.65; 95% CI: 0.46–0.93).

CONCLUSIONS: e-AT use led to high and sustained participation in self-monitoring and improved asthma outcomes. Dissemination of this care model has potential to broadly improve pediatric ambulatory asthma care.

Overall Impact

⬆ Improved asthma control and QQL

⬇ 57% reduction in missed school days

⬇ 63% reduction in missed work days

⬇ 35% reduction in oral corticosteroids use

⬇ 59% reduction in ED/hospital admissions

⬇ 69% reduction in asthma related costs

NO CHANGE IN CONTROLS

⬇ 59% reduction in **overall** health care costs

▪ Eliminated asthma control/QOL disparities in minorities

Dissemination and Implementation of the e-AT

Funded by PCORI

Dissemination Project: Aims

- Implementation of the e-AT to allow scalability at clinic and health plan levels
  - Health plan level: Phase 1 (small scale testing), Phase 2 (large scale implementation)
  - Clinic level: Implementation in 3 waves in SWD
  - Enrollment target: 3000-5000 children with asthma

- Evaluate impact of e-AT using the RE-AIM Framework
  - Outcomes: ED/Hospital Admissions, Oral Steroid use, Asthma Medication Ratio, Asthma Control, Missed School/Work days, Parent Satisfaction and Self-management Skills

- Assess implementation process factors that promote adoption and sustainability (guided by CFIR)

Dissemination and Implementation Models
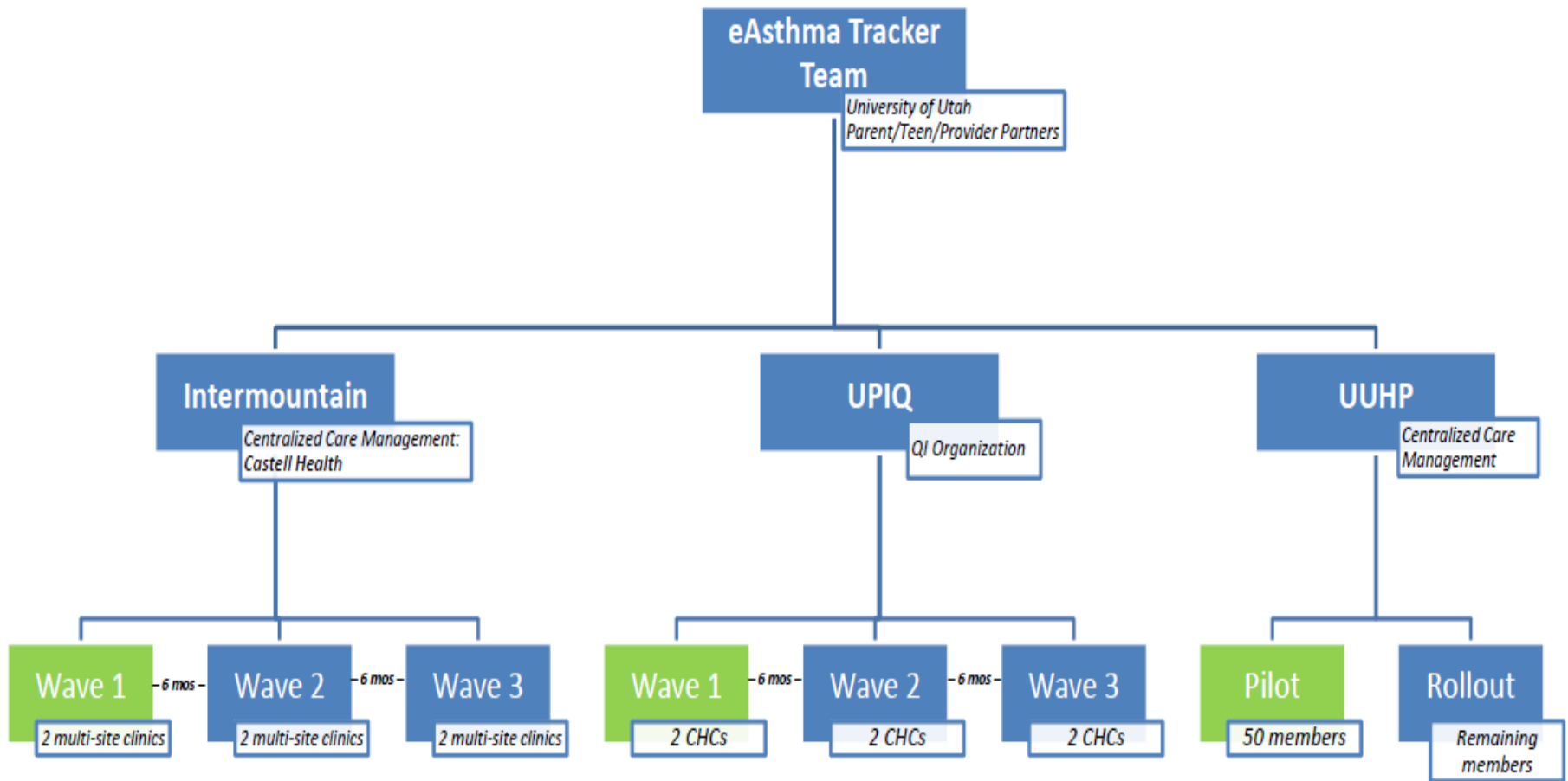
Implementation Strategies: Facilitation   Evaluation strategy: RE-AIM & CFIR

Dissemination Project: Overall Goals

- Determine an optimal healthcare system approach to implement the e-AT intervention and facilitate adoption

- Determine savings and incentive (e.g. value-based care, pay for performance, etc.) needed to sustain the e-AT

- Determine an optimal approach to institutionalize the e-AT into the ongoing, stable operations of an organization

- Determine an optimal patient level approach to implement the e-AT intervention (reach and sustainability)

- Develop a standardized approach and a packet for future e-AT dissemination at various healthcare systems

Conclusion (Lesson Learned)

- Engagement key organization stakeholders

- Leadership commitment and support

- Data driven culture with organizations

- Data and analytical capability

- Aligning incentive (value-based care) with changes

- PCP engagement key to self-monitoring program success

- External Funding to support **non** QI work

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1. 1R18HS018166-01A1 (AHRQ) Title: Organizational Factors Associated with Improved Inpatient Pediatric Asthma Care. PI: Nkoy

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