HOW DO YOU MEASURE ADHERENCE FOR HIGH RISK PATIENTS?

Kristin A. Riekert, PhD
Associate Professor, Pulmonary & Critical Care Medicine
Director, Johns Hopkins Adherence Research Center
Co-Chair, Cystic Fibrosis Foundation Success with Therapies Research Consortium

What do we know about this person?

- Female
- Married
- Obese
- Smoker
- Drinker

Should we start her on an antihypertensive medication?

Being “at risk”

≠

Having a diagnosis requiring treatment

WHO'S "AT RISK" FOR NONADHERENCE?

- Minority
- Male
- Teenagers
- Elderly
- Low SES
- Low education/health literacy
- Multiple co-morbidities
- Complex treatment regimen
- High side effects
- Low perceived necessity or benefit of treatment
- Lack of social support
- Depression
- Substance abuse
- Chaotic or disorganized lifestyle

Etc…

Nonadherence “risk” scores are often proposed for clinical use.

HOWEVER

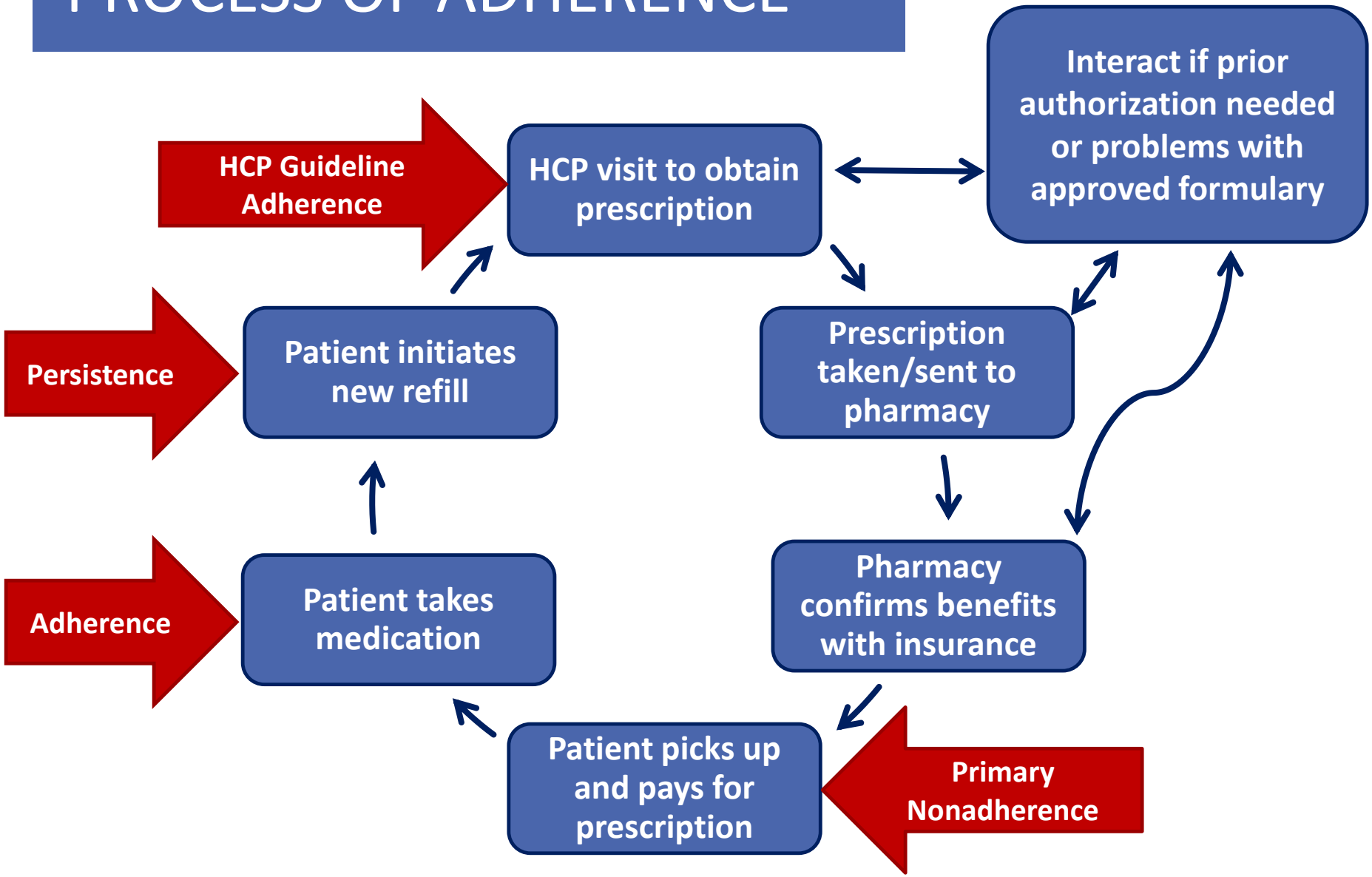
If we don’t treat “at risk” for a medical diagnosis, should we treat “at risk” for nonadherence?

ADHERENCE

"The extent to which a person's behavior (in terms of taking medications, following diets, or executing lifestyle changes) coincides with medical or health advice."

~~Haynes, 1979

PROCESS OF ADHERENCE



HEAD START FAMILIES' ASTHMA MEDICATION AVAILABILITY

	N (%) N = 228
Names all the medications on the treatment plan	190 (83%)
Identifies rescue medication	201 (88%)
Identifies controller medication, (n = 150 prescribed a controller)	126 (84%)
Locates all the prescribed medications in the home	124 (54%)
Medications are expired	58 (47%)
Describes the purpose of the medication counter	68 (55%)
Counter at 0	58 (47%)
Can access medication in home that is not expired or empty	**52 (23%)**

Eakin et al. ATS 2015 Monday afternoon Mini-symposium B94 Reducing Health Disparities For Children With Asthma

MEASURING ADHERENCE

FROM A BEHAVIOR CHANGE PERSPECTIVE

MEDICATION ADHERENCE MEASURES

- **Clinical Judgment**
- **Self-Report:** clinical interview, questionnaire, diary
- **Medication Measurement:** pill count, canister weighing
- **Pharmacy Refills**
- **Electronic Monitors**
- **Biochemical Measures:** assays of DRUG LEVELS in blood, saliva, urine

CLINICAL JUDGMENT

Advantages

- Fast
- Inexpensive
- Easy
- Standard component of clinical practice

Disadvantages

- Physician factors
  - poor interviewing skill
  - bias
  - stereotyping
- Patient factors
  - social desirability
- Equating health outcome with adherence

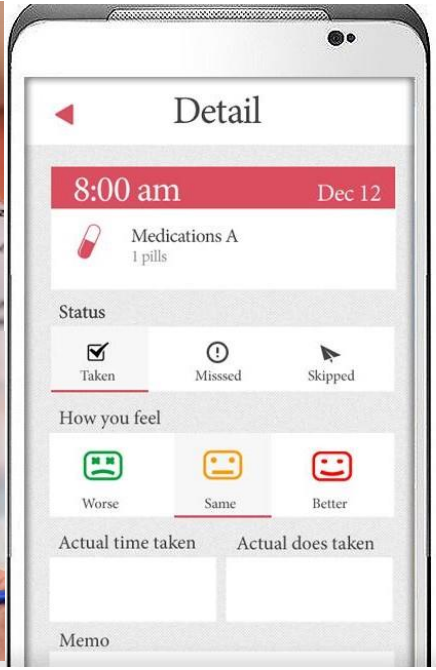
PATIENT-REPORT

Advantages

- Inexpensive
- Easy
- Suitable for clinical care
- Identify adherence barriers
- High specificity for non-adherence

Disadvantages

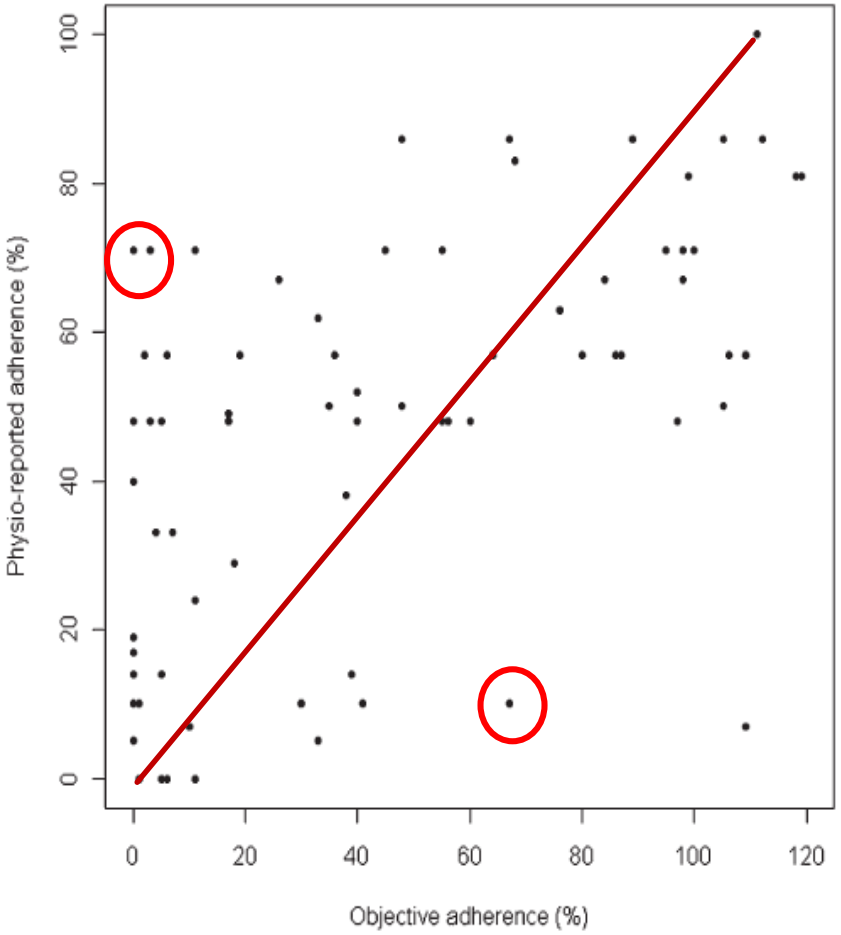
- Social desirability
- Memory limitation
- Interviewer skills



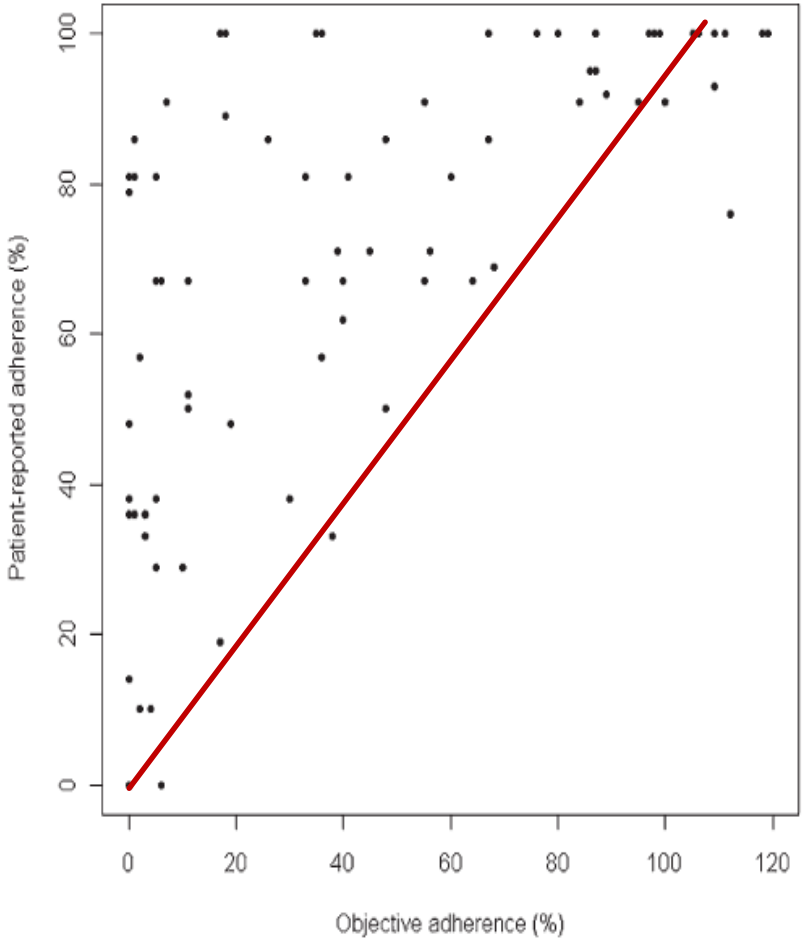
Daniels et al. *Chest* 2011;140:425-32

INACCURACY OF SUBJECTIVE REPORTS

Provider Report



Patient Report



MEDICATION MEASUREMENT

Advantages

- Objective index of “maximum” use
- Provides some dose-response data
- Inexpensive within a research setting

Disadvantages

- Does not measure patterns of use
- Vulnerable to “dumping”
- Requires two counts to get estimate

PHARMACY REFILL

Advantages

- Objective index of “maximum” use
- Provides some dose-response data
- Suitable for clinical care and many research studies
- Included in EMRs

Disadvantages

- May not capture primary non-adherence
- Requires “closed” dispensing system
- Cannot confirm medicine is actually taken
- Does not measure patterns of use
- Not sensitive to recent or transient changes in medication use

BIOMARKERS

Advantages

- Only adherence measure that confirms ingestion
- Good validity and reliability
- Sometimes a component of clinical management

Disadvantages

- Generally only confirms use for prior 24-48 hours
  - →white coat compliance
- Does not measure patterns of use
- Not available for most medicines
- Many factors can affect results
  - metabolism, genetics, recent medication use, etc.

CLARIFICATION

- **What ISN'T a biomarker of Adherence**
  - A health outcome…even if it is known to be correlated with adherence
    - Hemoglobin A1C (Diabetes)
    - Viral Load (HIV)
    - Indicators of graph rejection (Transplant)
- **What IS a biomarker**
  - Drug levels such as
    - Nevirapine & other antiretroviral drugs (HIV)
    - Tacrolimus & other antirejection drugs (Transplant)
    - Carbamazepine & other antiepileptic drugs (Epilepsy)

ELECTRONIC MONITORS

Advantages

- Can provide detailed information on patterns of use
- Excellent source of information for assessing dose-response relationship
- Can identify medication “dumping”
- Under some circumstances may enhance adherence

Disadvantages

- Cannot confirm ingestion
- Vulnerable to technical problems
- Can be expensive (relative)
- Potentially reactive
- Not currently available for all medicines
- May interfere with established routines
- May requires staff training to train patients and monitor data quality

TYPES OF ELECTRONIC MONITORS

CPAP

AdhereTech

Propeller Health

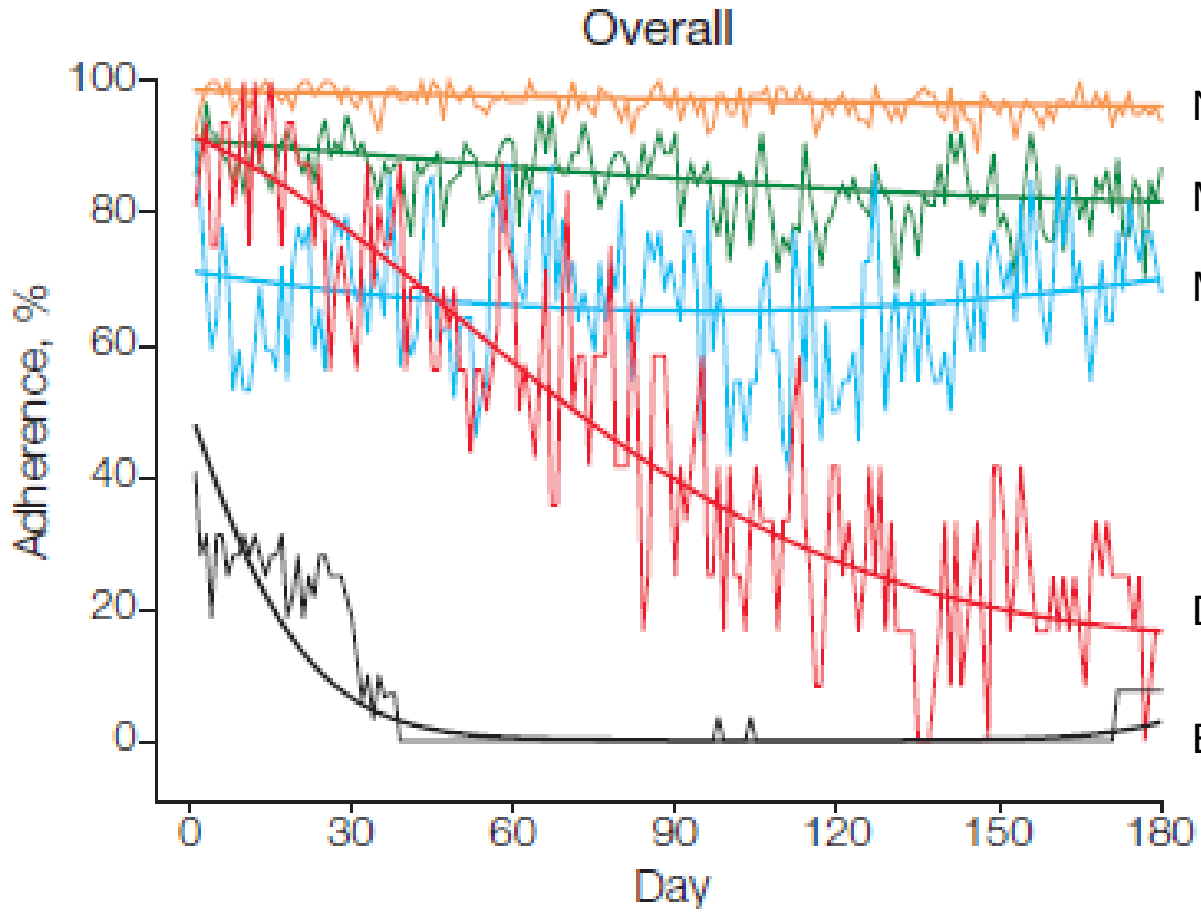
I-Neb

Medminder

Blood Glucose Meters

POPULATION HEALTH & PERSONALIZATION OF CARE

ADHERENCE TRAJECTORIES



Near Perfect (42%)

Mild nonadherence (26%)

Moderate nonadherence (13%)

Delayed Severe nonadherence (7%)

Early Severe nonadherence (13%)

Modi et al. JAMA. 2011;305(16):1669-1676

PATTERNS OF ADHERENCE

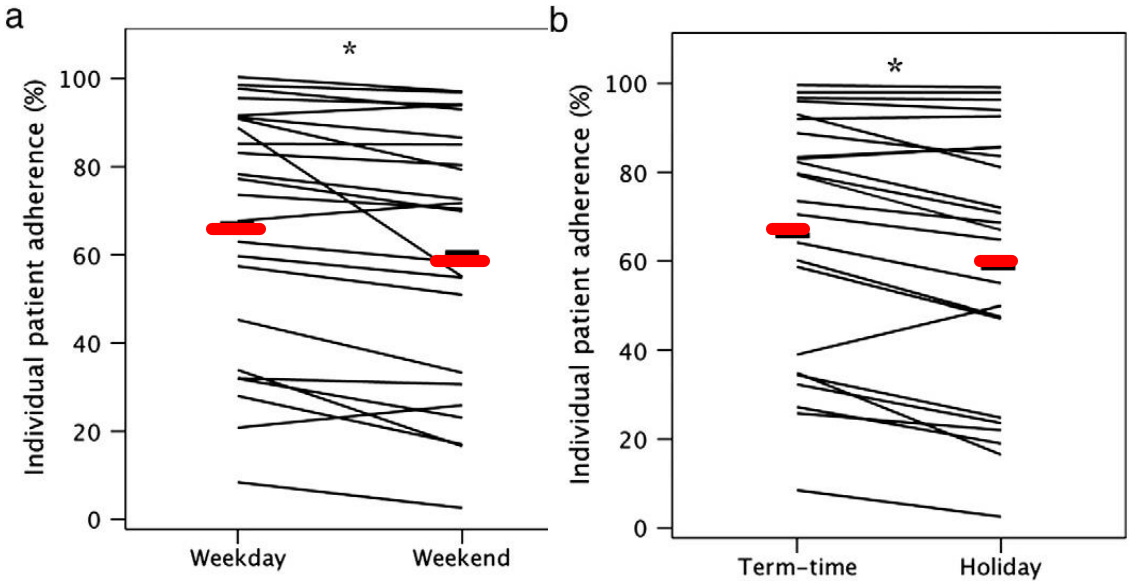


Fig. 1. Comparison of adherence to treatment for individual patients during a) weekdays and weekends and b) holidays and term-times. The horizontal thickened bars represent mean adherence for the group (*p<0.001).

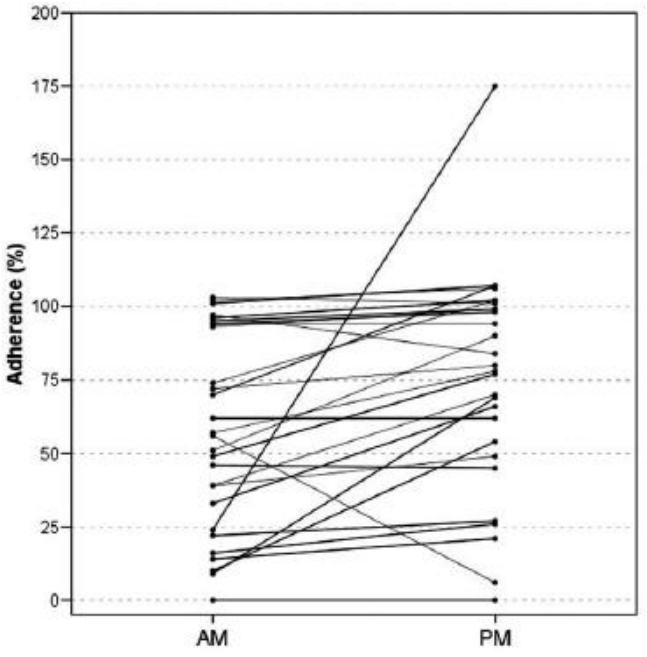
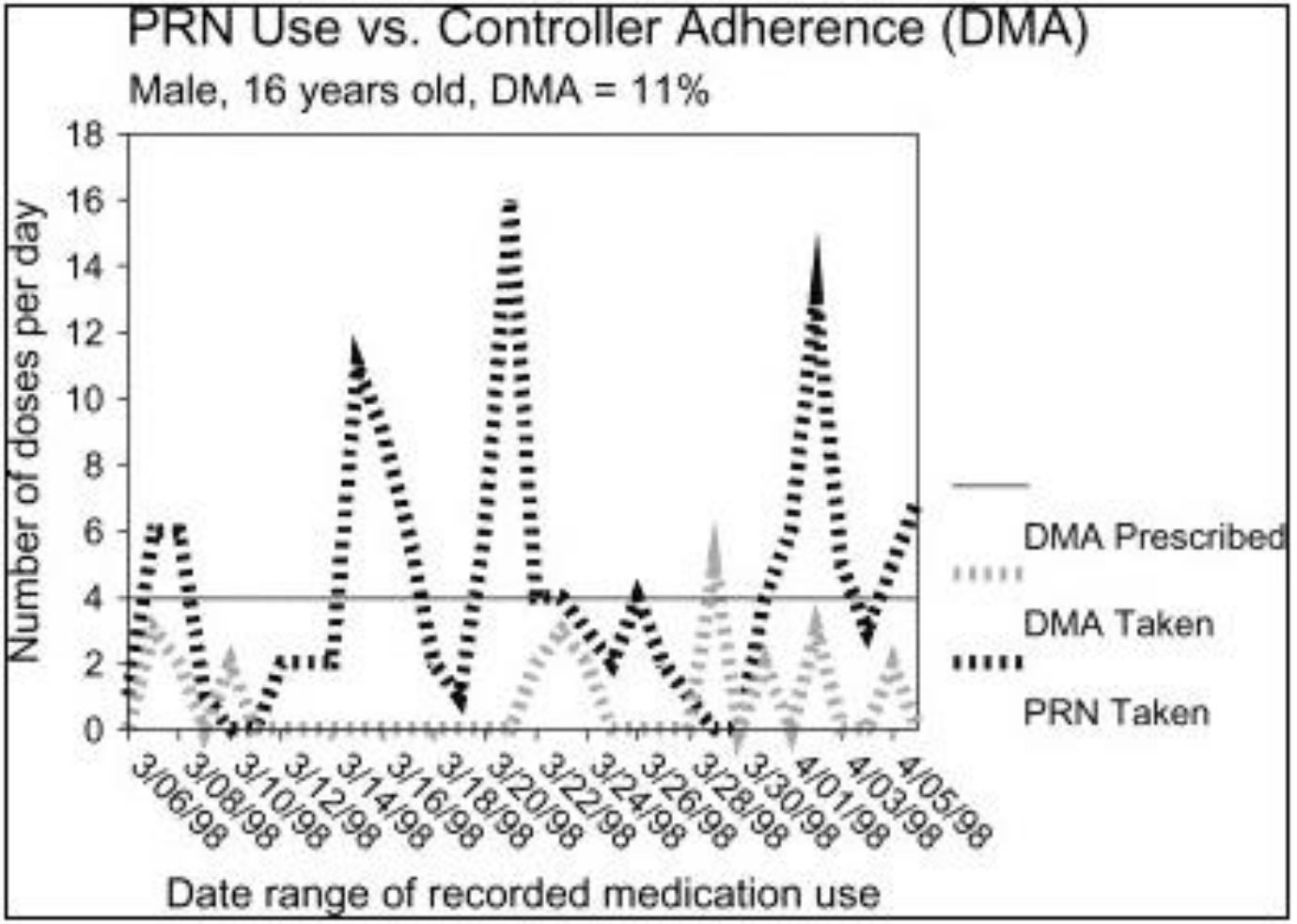


Fig. 2. Morning and evening adherence in children (n=28) for the six months following start of treatment. Evening adherence was significantly higher than that in the morning (p=0.012). The obvious outlier is a teenager who, on schooldays, took both his daily treatments immediately after school and towards midnight, rather than in the morning.

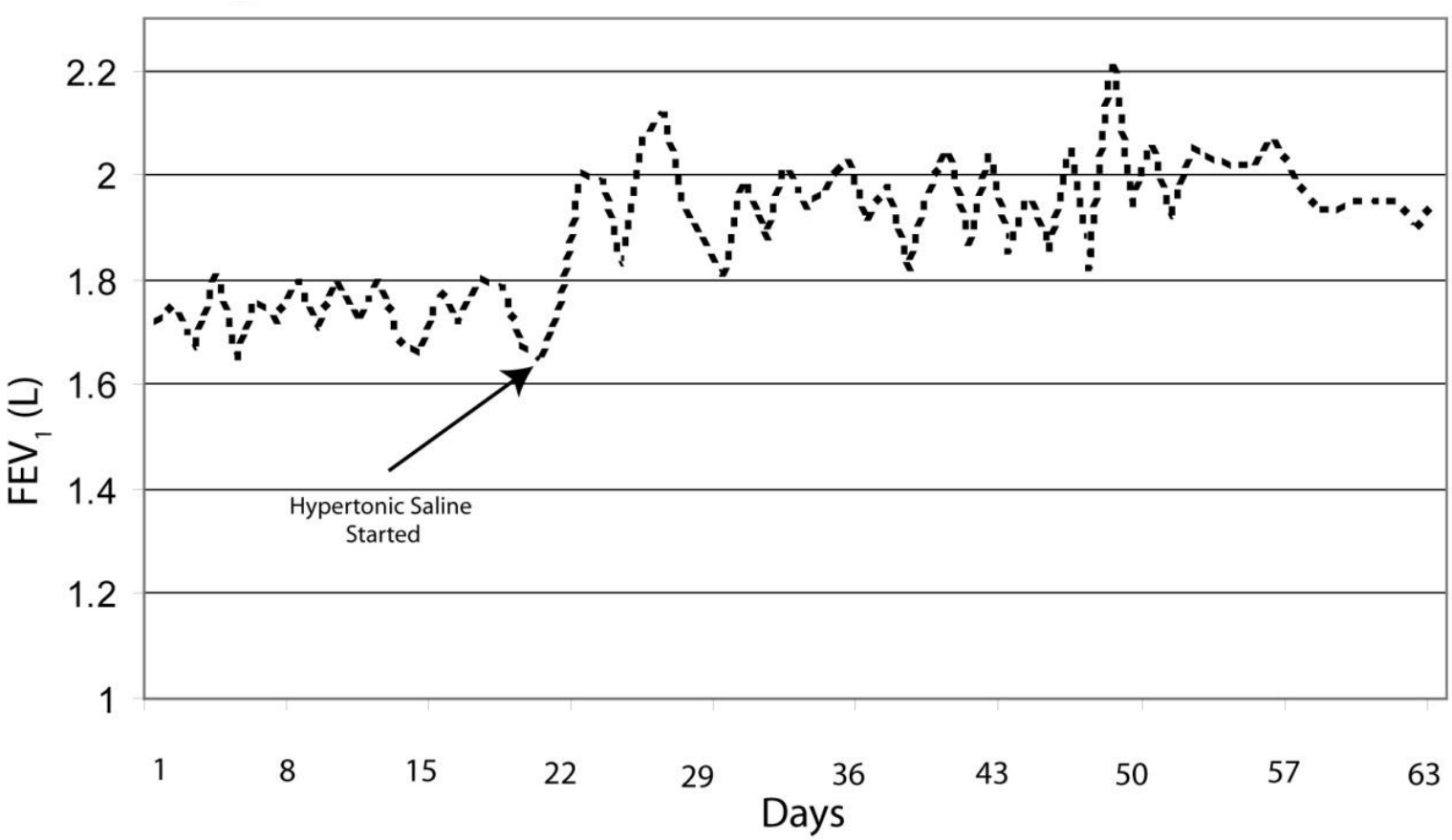
Ball et al. *J Cyst Fibros* 2013; 440-444
McNamara et al. *J Cyst Fibros* 2009; 258–263

EVALUATE PATTERNS OF USE



Walders et al., J Pediatr. 2005 Feb;146(2):177-82.

IS THE TREATMENT WORKING FOR ME?



Unpublished data courtesy of Dr. Noah Lechtzin, Johns Hopkins School of Medicine

WHAT TO DO WITH THE ADHERENCE DATA?

DO PHYSICIANS USE OBJECTIVE ADHERENCE DATA?

- Few actively request it
  - 22% ordered MEMS monitoring for patient with high BP
- Few look at it when posted in an EMR
  - Drug info with alert MPR<80% vs. list of meds prescribed
    - Profile reviewed: Intervention=44.5% vs. Control=35.5%
    - No group difference in adherence
  - MPR in ePrescribing with ‘click’ for details
    - No group differences in adherence

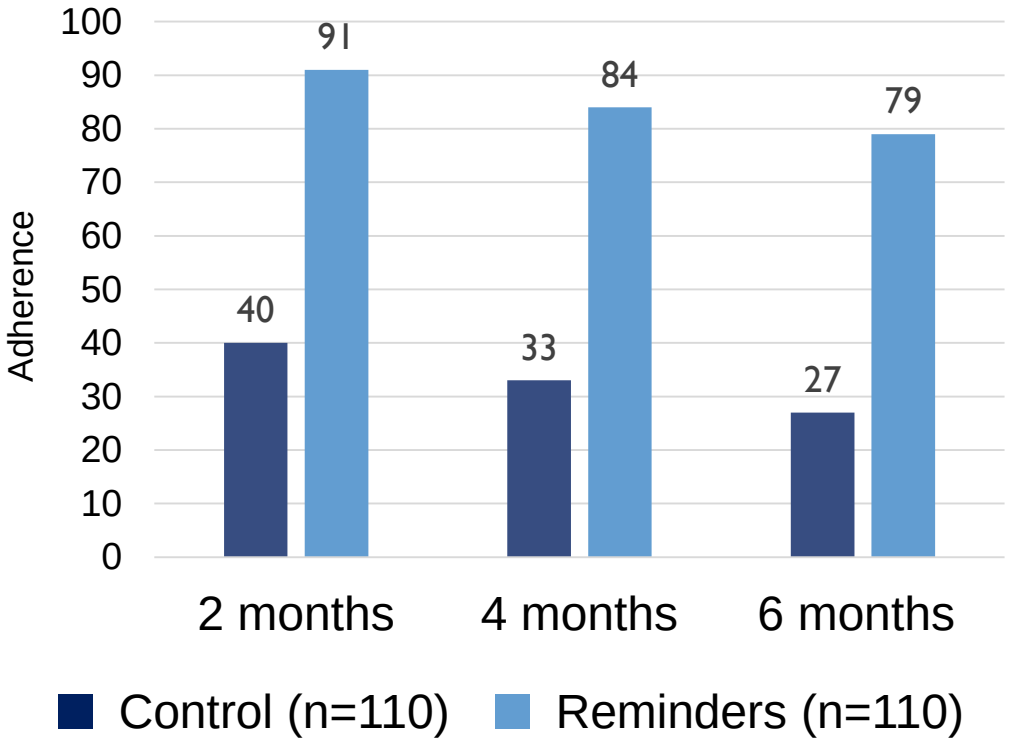
Status	N	MPR
Did not view	396 (28%)	12.3 ± 3.0
Viewed general	938 (68%)	25.1 ± 2.4
Viewed details	53 (4%)	35.7 ± 5.1

We can remotely measure adherence to learn about patterns.

Physicians don’t use the data.

What to do?

REMINDERS

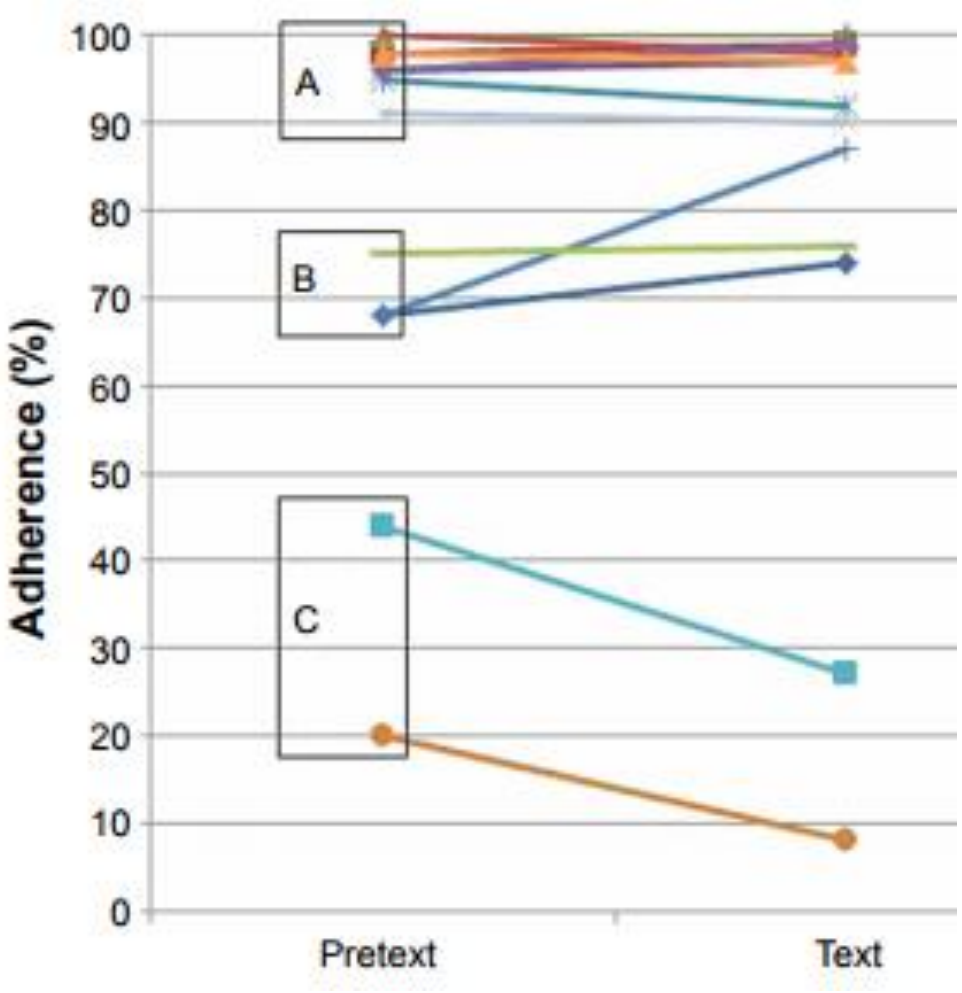


Chan et al. *Lancet Respir Med*. 2015;3(3):210-9

Similar results found with adults too! - Foster et al. *J Allergy Clin Immunol*. 2014;134(6):1260-1268

Morton et al *Patient Prefer Adherence* 2017;8:861-869

REMINDERS AREN'T ENOUGH



A= ≥80% Adherent at Baseline

B= 50-79% Adherent at Baseline

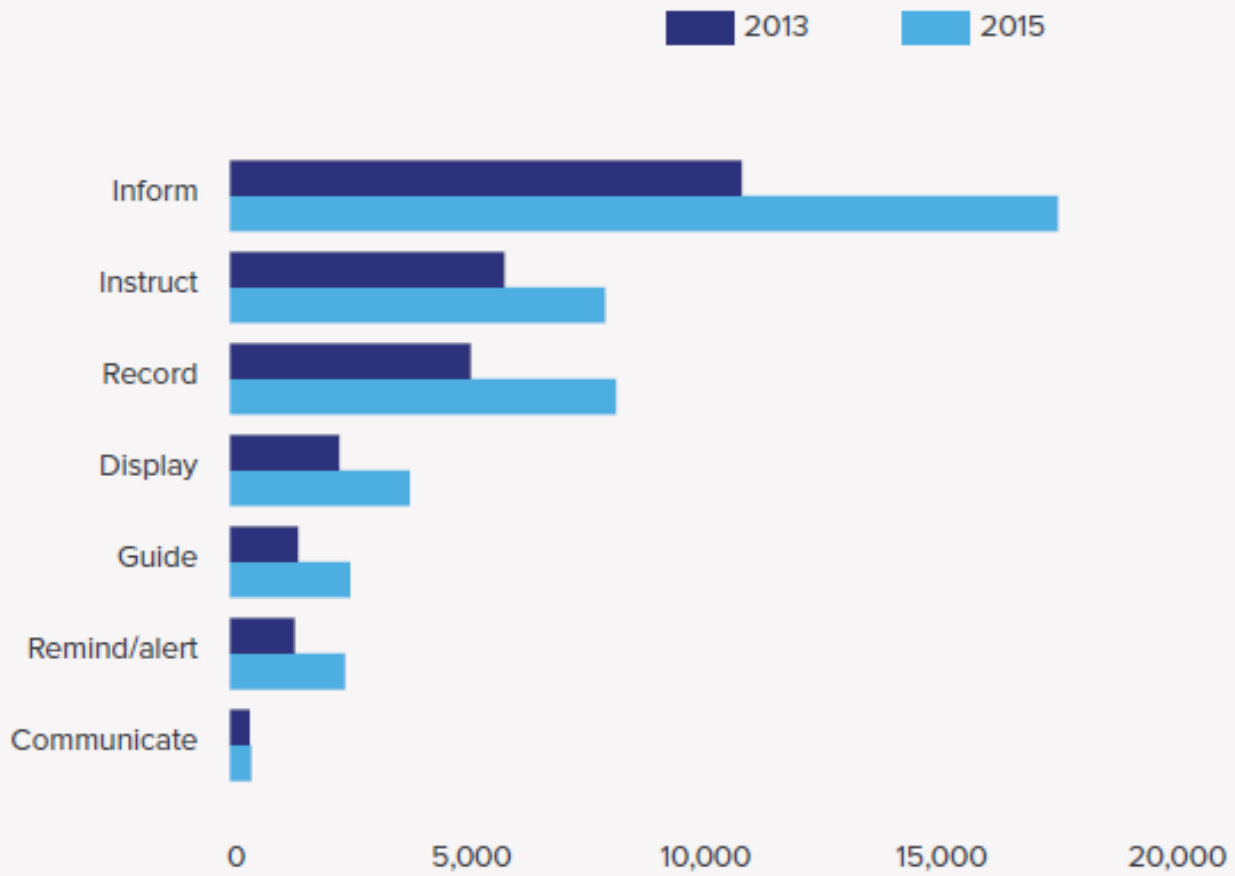
C= <50% Adherent at Baseline

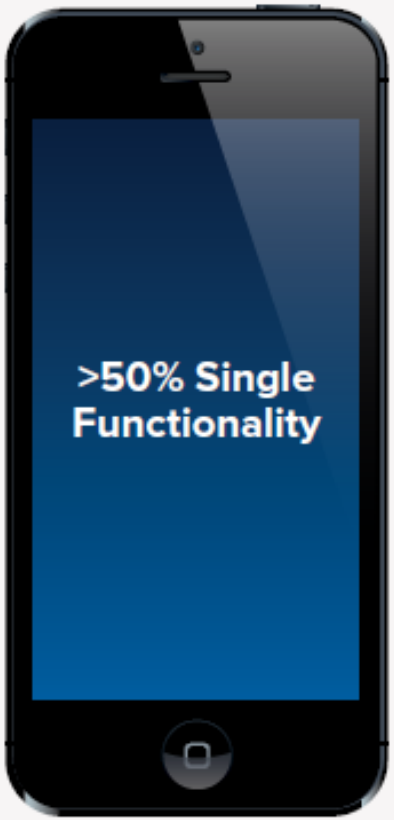
WHAT DO PEOPLE WITH CF WANT FROM A HEALTH APP?

- **App tailored to the unique, complicated experience of having and managing CF**
- **Information at one's fingertips**
  - educational, personal medical data, and CF management behaviors and association with health status
- **Automation of functions and integration with other technologies**
  - "smart reminders", automatic refill requests, automatic collection of data
- **Improved communication**
  - Care coordination between visits, providers or parents access to data
- **Socialization within the CF community**
  - Reduce isolation, build social supports, motivation and reinforcement

Hilliard et al. *JMIR mHealth uHealth* 2014; e44

APPS LACK NECESSARY FUNCTIONALITY TO SUPPORT ADHERENCE



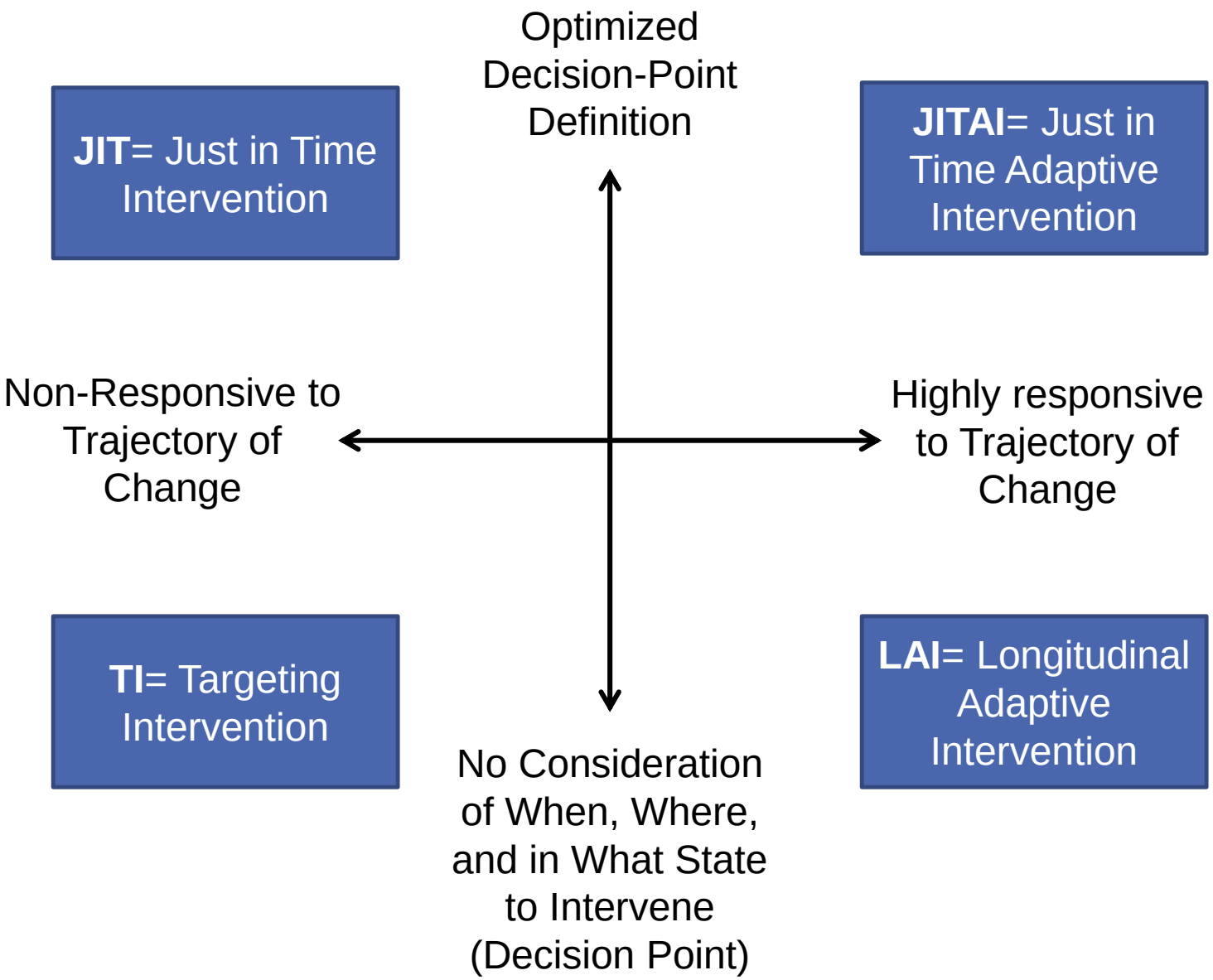


Source: IMS Health, AppScript, July 2015; IMS Institute for Healthcare Informatics, August 2015

https://medisafe.com

NEED TO USE THE DATA TO DRIVE INTERVENTIONS

- What intervention(s) change THIS person's behaviors?
  - "SMART" Intervention
    - Just in Time Adaptive Interventions (JITAI)
    - Machine Learning
- Delivered when the person demonstrates need
  - Not when adherence is good
  - Not after bad habits are established and reinforced


Optimized Decision-Point Definition
JIT= Just in Time Intervention
JITAI= Just in Time Adaptive Intervention
Non-Responsive to Trajectory of Change
Highly responsive to Trajectory of Change
TI= Targeting Intervention
LAI= Longitudinal Adaptive Intervention
No Consideration of When, Where, and in What State to Intervene (Decision Point)

ADDITIONAL CHALLENGES

- Can’t measure everything (yet)
  - Pill sorters
  - Blister packs
  - Liquid meds
  - Devices

- Data security
  - Data transfer issues (cell service)
- Ethics
  - Data privacy and sharing
  - Data being used punitively

CONCLUSIONS

- Adherence is a behavior that can be accurately measured
  - Interventions can occur when there is an identified problem vs. fitting a 'risk profile'
- Objective, passive electronic monitors may be most informative and feasible
- Allows for population and tailored individual level interventions
- Challenges remain
  - Monitoring options
  - Data security
  - Ethical challenges and potential misuse of data