

# Addressing Health Literacy and Numeracy: Lessons Learned over 25 Years

October 22, 2024

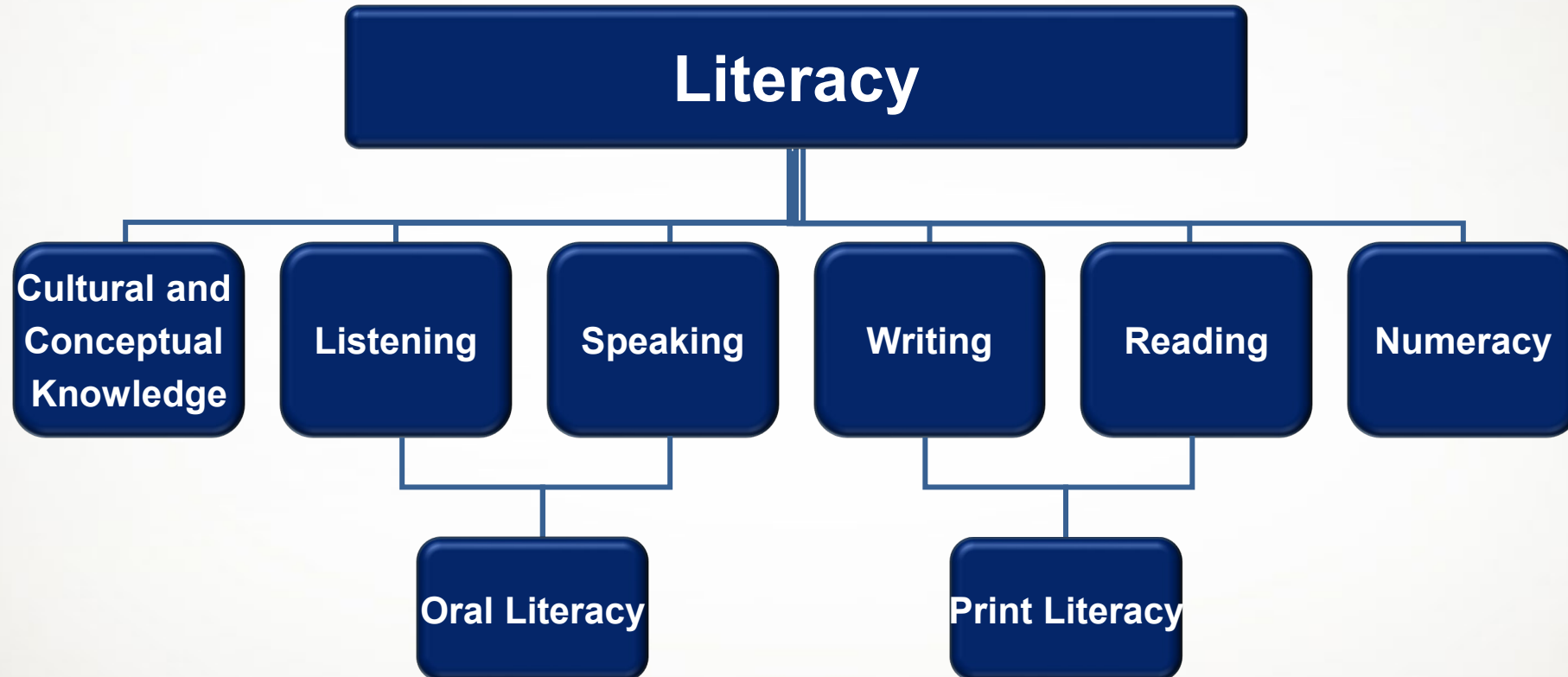
**Russell L. Rothman MD MPP**

Professor, Internal Medicine, Pediatrics and Health Policy  
Ingram Chair in Integrative and Population Health  
Senior Vice President, Population and Public Health  
Associate Dean, Population Health Sciences  
Director, Institute for Medicine and Public Health  
Vanderbilt University Medical Center

# Disclosures

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# Defining Health Literacy



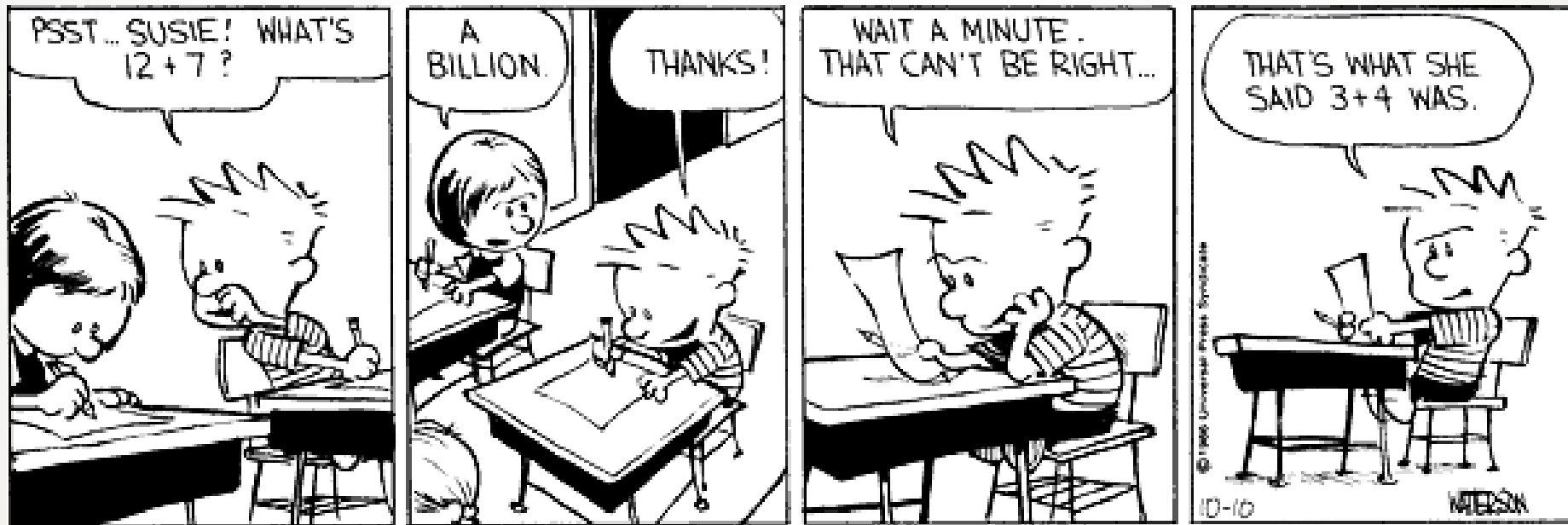
# Numeracy

- A component of overall literacy
- “The ability to understand and use numbers and math skills in daily life”
- Calculations, deduction/logic, interpretation of graphs/labels, time, probability, etc.

Rothman et al, J Health Comm, 2009

# Numeracy vs Literacy

- Highly correlated with literacy, but not perfect



Calvin and Hobbes, Bill Watterson, Universal Press Syndicate, Released on: Friday, Oct 10th 1986.

# Health Literacy/Numeracy and Health Knowledge

- Over 90% of patients struggle to understand food labels
- Over 2/3 of patients have poor estimation of portion sizes
- Parent struggle to understand OTC cold and cough medicines
- Parents struggle to understand growth charts, mixing formula, and other parenting activities.

The New York Times **Fitness & Nutrition**

WORLD | U.S. | N.Y. / REGION | BUSINESS | TECHNOLOGY | SCIENCE | HEALTH | SPORTS | OPINION

FITNESS & NUTRITION | HEALTH CARE POLICY | MENTAL HEALTH

VITAL SIGNS  
**Labeling: Nutritional Information Leaves Many Uninformed**  
 By ERIC NAGOURNEY  
 Published: September 26, 2006

[Nutrition](#) labels contain a wealth of information for people watching their weight or keeping an eye on other health issues.



But a new study has found that the messages are not getting through to many people who lack the reading or math skills needed to decipher them.

“Many patients were confused by the complexity of the nutrition label and could not find the proper information,” said the study, which appears in *The American Journal of Preventive Medicine*.

Stuart Goldenberg

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ARTICLE TOOLS  
 SPONSORED BY  
**THE LAST KING OF SCOTLAND**  
 NOW PLAYING

Easy Directions for Preparation & Use

Your baby's health depends on carefully following these directions. Ask your baby's doctor about infant formula use including the need to boil water for formula, bottle, and nipple assembly.



Pour desired amount of warm water into bottle. Add powder, cap bottle and shake vigorously. Use the following chart for correct amounts of water and powder.

To Make	Water	Powder
2 oz bottle	2 fl oz	1 unpacked level scoop (8.5 g)
4 oz bottle	4 fl oz	2 unpacked level scoops (17 g)
6 oz bottle	6 fl oz	3 unpacked level scoops (25.5 g)
8 oz bottle	8 fl oz	4 unpacked level scoops (34 g)
1 quart	29 fl oz	1 unpacked level household measuring cup (124 g)

Feed immediately, or cover and refrigerate prepared formula. Use within 48 hours. Throw away prepared formula left in feeding bottle or cup within one hour after feeding begins. Warning: Do not use a microwave oven to warm formula. Serious burns may result. Storage: Store cans at room temperature. After opening can, keep tightly covered, store in dry area and use contents within one month. Do not freeze powder or prepared formula. Avoid excessive heat.

USE BY DATE ON CAN END.

# Enfamil

## with Iron

### Infant Formula

Milk-Based for Baby's First 12 Months

Powder

Makes 105 fl oz

14.3 OZ (406 g)

Mead Johnson

Infants & Children

# LITTLE COLDS

REUSABLE FOREHEAD THERMOMETER BONUS INSIDE!

## MULTI-SYMPTOM COLD FORMULA

Nasal Decongestant / Cough Suppressant / Fever Reducer / Pain Reliever

**Safely & Gently Relieves**

- ✓ Stuffy Noses
- ✓ Coughs
- ✓ Fever & Pain

NO SACCHARIN, ALCOHOL OR PPA

NATURAL BERRY FLAVOR

DYE FREE ORAL DROPS

1FL OZ (30 mL)



Rothman et al, *AM J Prev Med*, 2006  
 Huizinga et al, *Am J of Prev Med*, 2009  
 Kumar et al, *Academic Pediatrics*, 2010  
 Yin et al, *Academic Pediatrics*, 2011  
 Lokker et al, *Pediatrics*, 2009

LIVE

HOUSE CALL

CNN READING FOOD LABELS 9:26a ET

ON ITS!

TIP OF THE HAT THE WAG FINGER

### Nutrition Facts

Serving Size 1/2 cup (114g)  
 Servings Per Container 4

Amount Per Serving	Calories 90	Calories from Fat 30
	% Daily Value*	
<b>Total Fat</b> 3g		<b>5%</b>
Saturated Fat 0g		<b>0%</b>
<b>Cholesterol</b> 0mg		<b>0%</b>
<b>Sodium</b> 300mg		<b>13%</b>
<b>Total Carbohydrate</b> 13g		<b>4%</b>
Dietary Fiber 3g		<b>12%</b>
Sugars 3g		
<b>Protein</b> 3g		
Vitamin A 80%	Vitamin C 60%	
Calcium 4%	Iron 4%	

\* Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

	Calories: 2,000	2,500
Total Fat	Less than 65g	80g
Sat Fat	Less than 20g	25g
Cholesterol	Less than 300mg	300mg
Sodium	Less than 2,400mg	2,400mg
Total Carbohydrate	300g	375g
Dietary Fiber	25g	30g

Calories per gram:  
 Fat 9 • Carbohydrate 4 • Protein 4

# Health Numeracy Linked to Worse Diabetes Knowledge and Control

- Difficulties performing many literacy and numeracy related diabetes tasks:
  - Over 25% of patients could not interpret glucose meter
  - Over 40% could not calculate carbohydrate intake
  - Over 30% could not dose insulin correctly
- Self-care skills linked to underlying numeracy.
- Diabetes numeracy skills associated with self-management, self-efficacy, and A1C.



Amount Per Serving	
Calories 140	Calories from Fat 60
% Daily Value*	
Total Fat 6g	10%
Saturated Fat 0.5g	4%
Cholesterol 0mg	0%
Sodium 160mg	7%
Total Carbohydrate 18g	6%

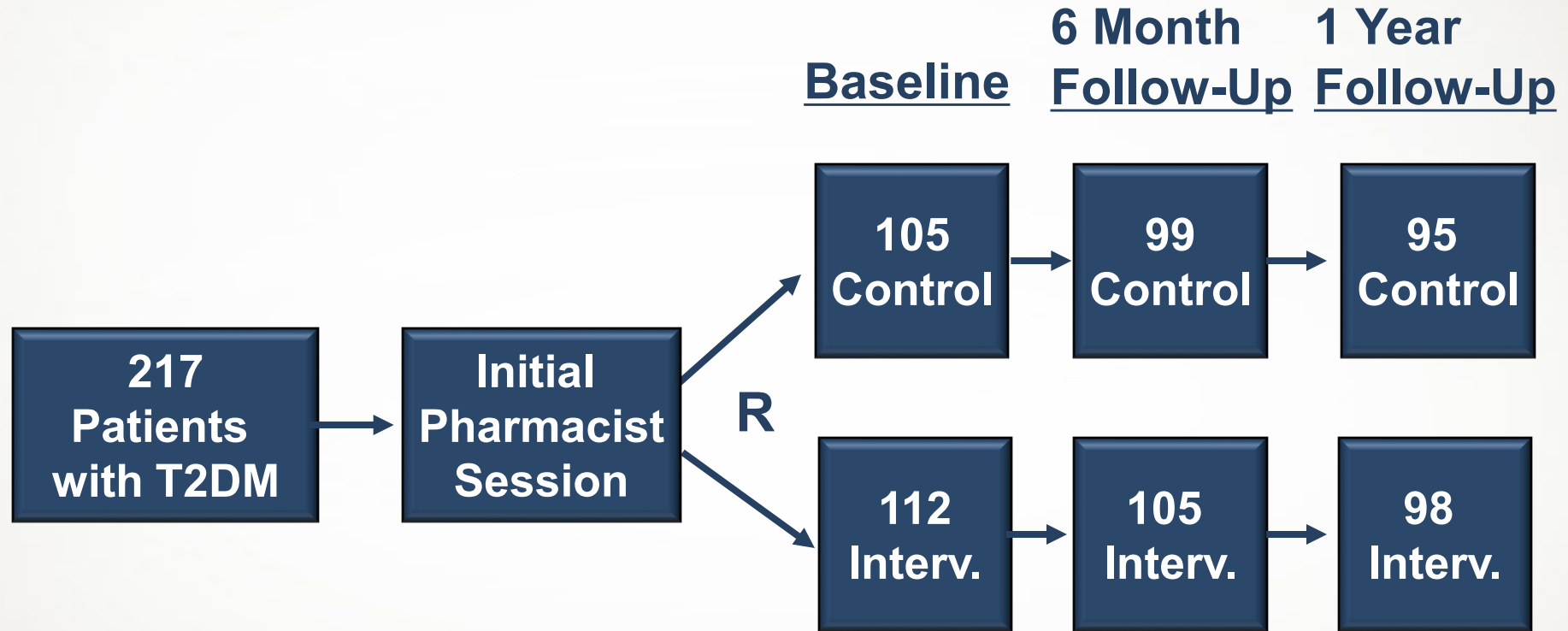
# Lesson #1

- Literacy is a complex social determinant
- Can measure reading/writing skills, but literacy is often more complex/applied than that
- Subject heuristics/beliefs and approach to health can override “literacy skills”
- Measuring literacy is often a surrogate for multiple social factors

# Literacy Interventions



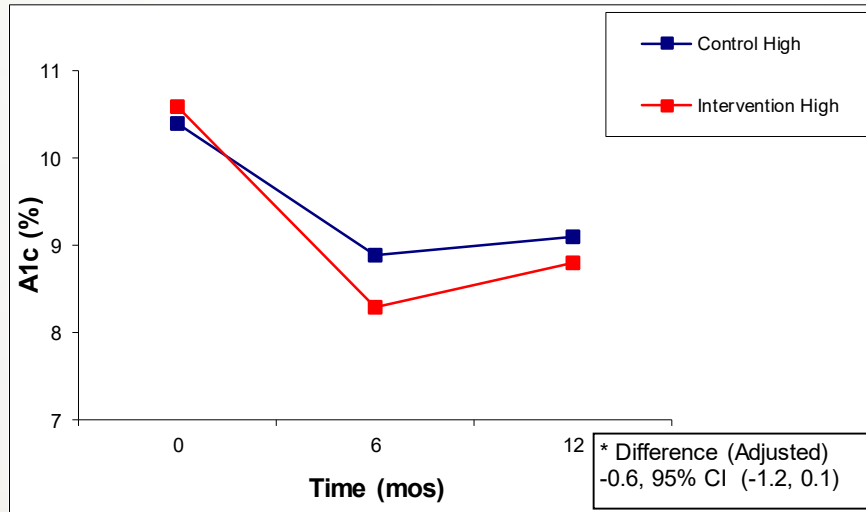
# Initial Diabetes Intervention



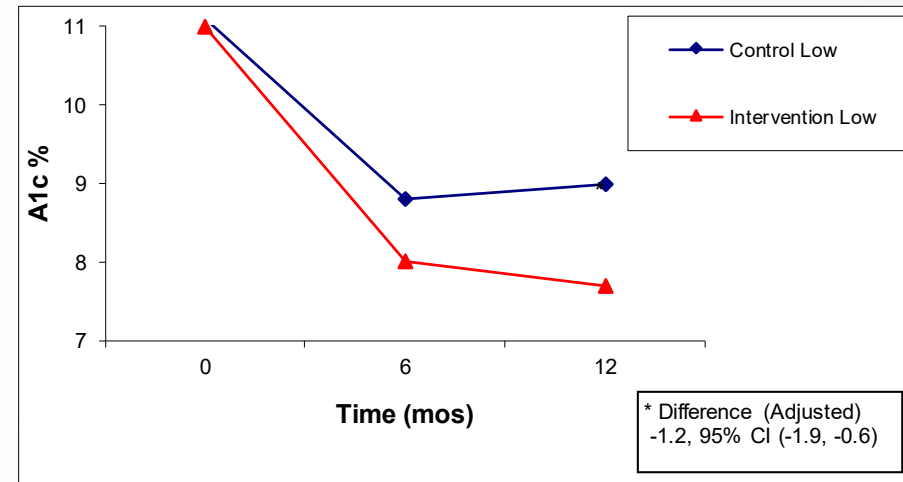
# Significant Clinical Improvements at 12 months

Variable	Control (n=95)	Intervention (n=98)	Difference
A1C (%)	-1.2%	-2.1%	0.9% (0.8,1.0)
SBP (mmHg)	+2.3	-6.9	9.2 (2.3,16.1)
DBP (mmHg)	+1.2	-3.6	4.8 (1.1,8.6)
ASA (mmHg)	+6%	+47%	41% (25-55)
T. Chol. (mg/dL)	-12	-27	15 (-4, 35)

# Literacy was an Important Factor



High Literacy Patients



Low Literacy Patients

# Diabetes and Numeracy RCT

## THE ABC'S & 123'S OF DIABETES CARE



### Taking care of your diabetes

If you have diabetes, you need to:

- Check your blood sugar every day.



- Be aware of how much starch and sugar (carbohydrates) you eat at every meal.



- Be active every day!



- Take your diabetes medicines every day



- Clean and look at your feet every day.



- Go to your doctor's office for regular check-ups.

# DLNET Toolkit

PART 2

## TESTING YOUR BLOOD SUGAR

### Test Your Blood Sugar Every Day

#### Why should I test my blood sugar?

- To know if your blood sugar is too high or too low
- So your doctor or nurse will know how your diabetes is doing to help control your diabetes



#### What does my blood sugar test result mean?

	If Blood Sugar Is: Over 300.....This is very high. Call your doctor or nurse at _____ if it stays this high for 2-3 days.
	181-300.....This is too high. Call your doctor or nurse if it stays high for over a week. 121-180.....This is a little high before meals.
	70-120.....This is perfect before meals.
	Below 70.....This is too low. Eat 3-4 glucose tablets or _____ Call your doctor or nurse at _____ if you have more than _____ lows in a week.
<b>If you are worried that your blood sugar is too high or too low, call your doctor or nurse at _____</b>	

1

PART 2

Text at 5<sup>th</sup> grade reading level

Color coding

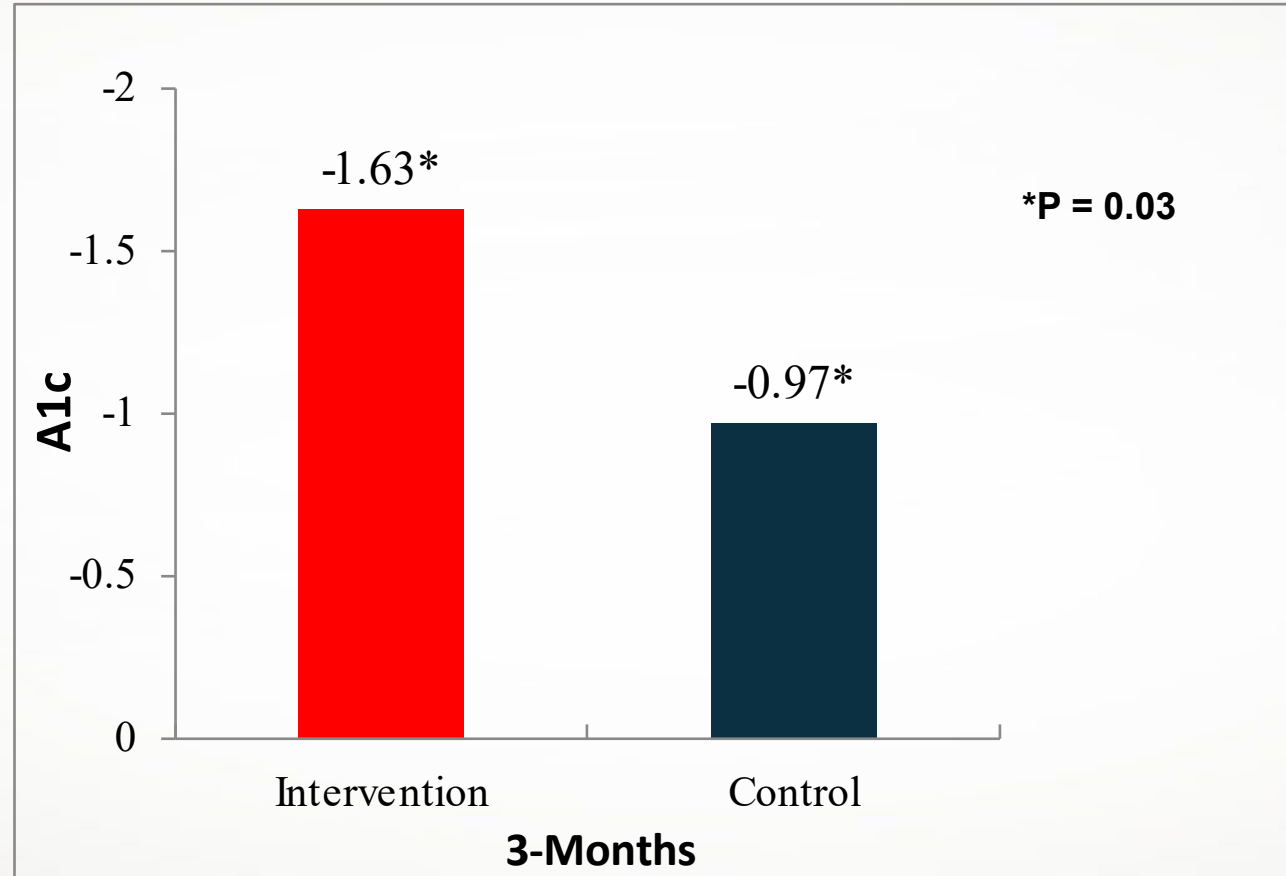
Pictures for key concepts

Step-by-step instructions

Simplified medication instructions

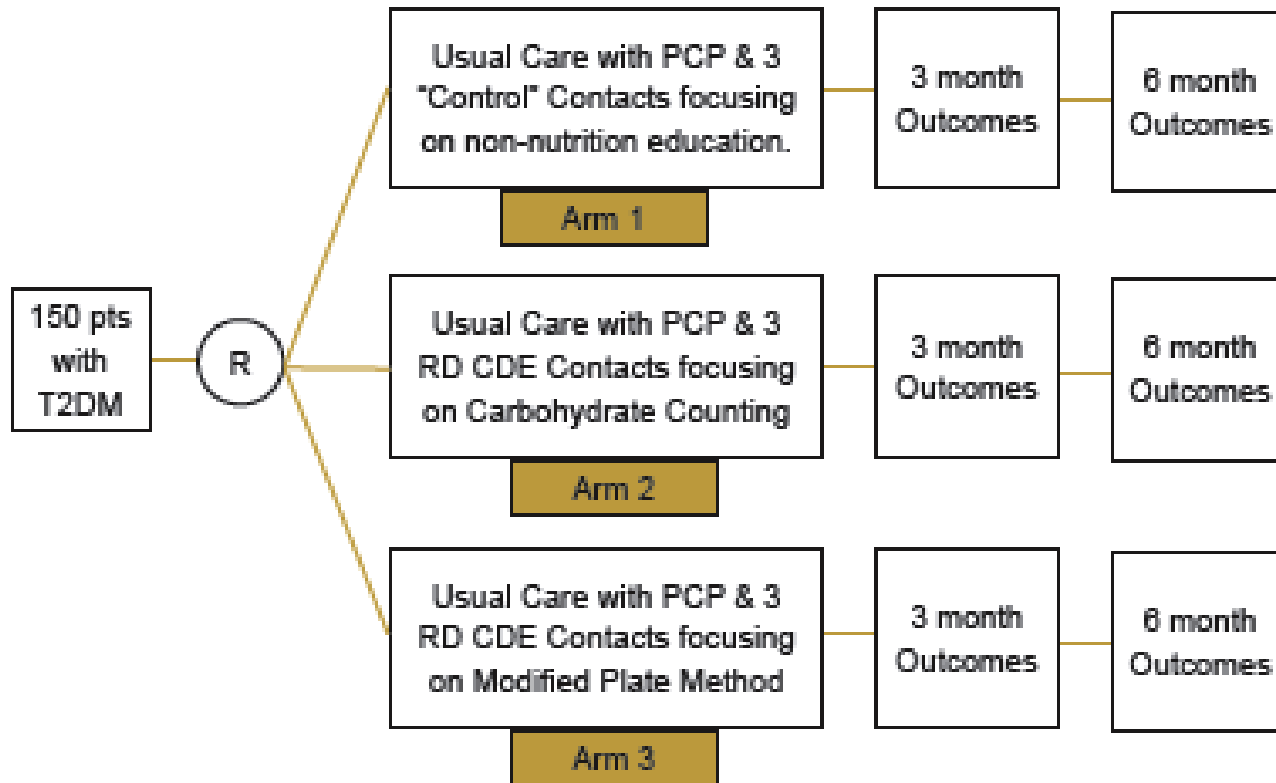
Practice skills worksheets

# Study Demonstrates Value of Addressing Health Literacy/Numeracy



\*Adjusting for age, gender, race, type of diabetes, income level, site of intervention and baseline DNT score and Hba1c levels

# Diabetes Nutrition Education Study (DINES)



# Carb Counting vs Plate Method

## Practice One Serving Size

Use the label below:

What is the serving size? \_\_\_\_\_

How many carbohydrate grams are in each serving? \_\_\_\_\_

If you eat one serving, you will get \_\_\_\_\_ grams of carb.

### Nutrition Facts

Serving Size 2 crackers (14 g)  
Servings Per Container About 21

Amount Per Serving

Calories 60 Calories from Fat 15

% Daily Value\*

Total Fat 1.5g 2%

Saturated Fat 0g 0%

Trans Fat 0g

Cholesterol 0mg 0%

Sodium 70mg 3%

Total Carbohydrate 10g 3%

Dietary Fiber Less than 1g 3%

Sugars 0g

Protein 2g

Vitamin A 0% • Vitamin C 0%

Calcium 0% • Iron 2%

\* Percent Daily Values are based on a 2,000 calorie diet. Your daily values may be higher or lower depending on your calorie needs.

Calories: 2,000 2,500

Total Fat Less than 65g 80g

Sat Fat Less than 20g 25g

Cholesterol Less than 300mg 300mg

Sodium Less than 2400mg 2400mg

Total Carbohydrate 300g 375g

Dietary Fiber 25g 30g

2 servings is \_\_\_\_\_ crackers

Add \_\_\_\_\_ grams of carb from 1 serving

+ \_\_\_\_\_ grams of carb from 1 serving

= \_\_\_\_\_ grams of carb from 2 servings

1/2 serving is \_\_\_\_\_ crackers

\_\_\_\_\_ grams of carb from 1 serving

divided by 2

= \_\_\_\_\_ grams of carb from 1/2 serving

3

PART 9

For Lunch And Dinner You Should Divide Your Plate Into 3 Parts

### 1 Free Foods

- Azuki sprouts
- Artichoke, Artichoke hearts
- Asparagus
- Beans, green or yellow
- Bean sprouts
- Beets, boiled
- Broccoli
- Brussel sprouts
- Cabbage, any kind
- Cauliflower
- Celery
- Cucumber
- Eggplant
- Green beans
- Greens, any kind, salad greens
- Lettuce, any kind
- Leeks
- Mushrooms, button, raw or cooked
- Onion
- Onion
- Pepper, any kind
- Peach
- Rhubarb
- Sauerkraut
- Snowpeas
- Sonch, raw
- Sprach
- Sprouts, any kind
- Squash, yellow (or spaghetti)
- Tomato
- Sugar snap peas
- Turkey
- Water chestnuts
- Zucchini

1 Fill up this part of your plate with Free Foods

2 Use this part of your plate for Protein Foods

2 Protein should be about the size of your palm

Meat
Chicken
Fish
Low-fat Cheese
Egg
Turkey
Cottage cheese
Shellfish

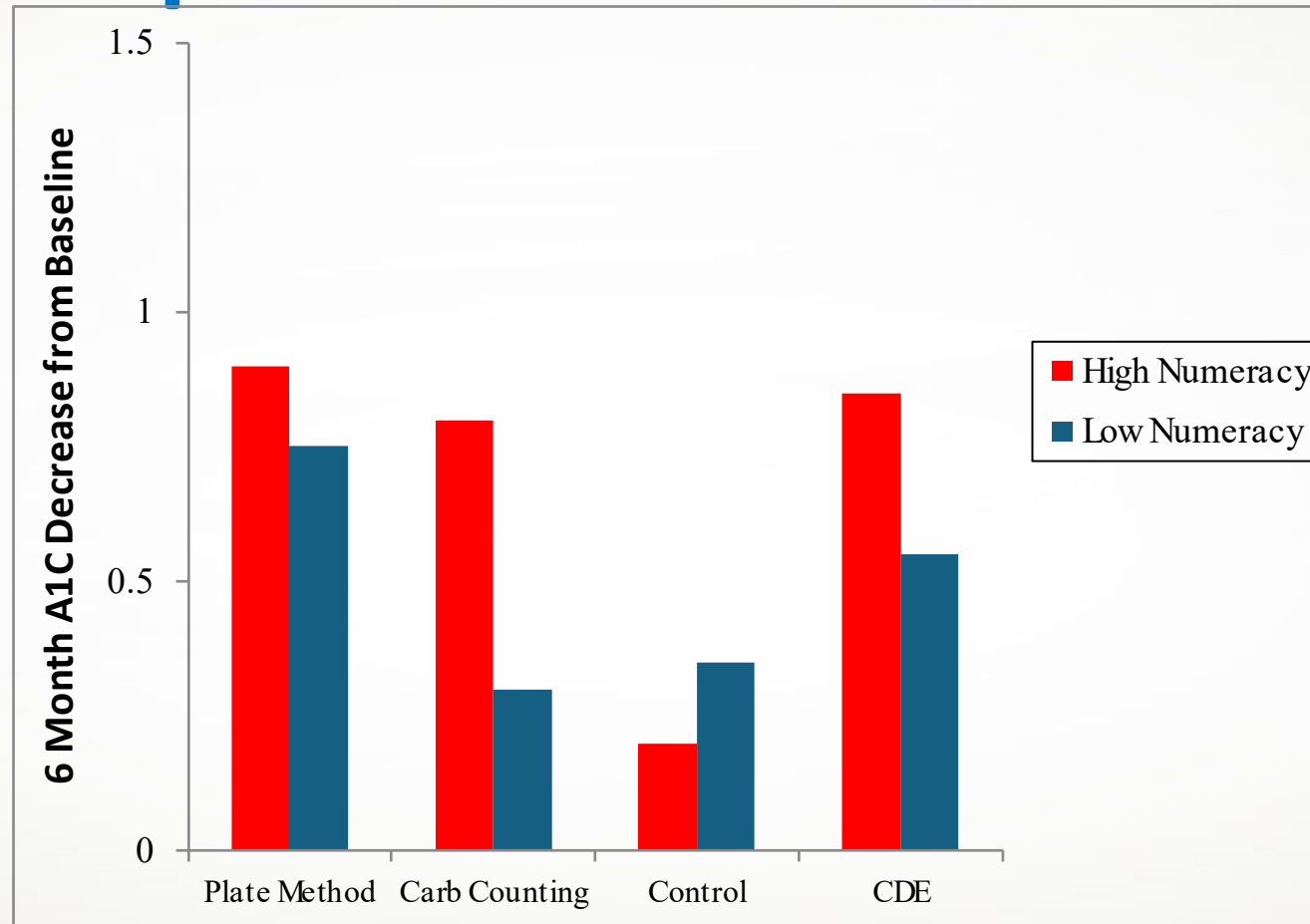
3 For Carbs you can have any \_\_\_\_\_ from this list

1 small bowl Potatoes
1 small bowl Rice
1 small bowl Beans, red, pinto or white
1 small bowl Corn
1 small bowl Flax
1 small bowl Noodles or macaroni
5 crackers
1 piece of bread or roll
1 cup of Milk
1 small bowl of Fruit
1 small glass of Juice
1 small bowl of low fat, sugar free Ice Cream
1 small bowl of sugar-free Pudding



3 Use this part of your plate for Carb Foods

# Results Demonstrate Value of Simpler Diabetes Education



# New Standards for Diabetes Education

## National Standards for Diabetes Self-Management Education and Support

LINDA HAAS, PHC, RN, CDE (CHAIR)<sup>1</sup>  
MELINDA MARYNIUK, MED, RD, CDE (CHAIR)<sup>2</sup>  
JONI BECK, PHARM, D, CDE, BC-ADM<sup>3</sup>  
CARLA E. COX, PHD, RD, CDE, CSSD<sup>4</sup>  
PAULINA DUKER, MPH, RN, BC-ADM, CDE<sup>5</sup>  
LAURA EDWARDS, RN, MPA<sup>6</sup>  
EDWIN B. FISHER, PHD<sup>7</sup>  
LENITA HANSON, MD, CDE, FACE, FACP<sup>8</sup>  
DANIEL KENT, PHARM, BS, CDE<sup>9</sup>  
LESLIE KOLB, RN, BSN, MBA<sup>10</sup>

SUE McLAUGHLIN, BS, RD, CDE, CPT<sup>11</sup>  
ERIC ORZECK, MD, FACE, CDE<sup>12</sup>  
JOHN D. PIETTE, PHD<sup>13</sup>  
ANDREW S. RHINEHART, MD, FACP, CDE<sup>14</sup>  
RUSSELL ROTHMAN, MD, MPP<sup>15</sup>  
SARA SKLAROFF<sup>16</sup>  
DONNA TOMKY, MSN, RN, C-NP, CDE, FADE<sup>17</sup>  
GRETCHEN YOUSSEF, MS, RD, CDE<sup>18</sup>  
ON BEHALF OF THE 2012 STANDARDS  
REVISION TASK FORCE

nonaccredited and nonrecognized providers and programs.

Because of the dynamic nature of health care and diabetes-related research, the Standards are reviewed and revised approximately every 5 years by key stakeholders and experts within the diabetes education community. In the fall of 2011, a Task Force was jointly convened by the American Association of Diabetes

Diabetes Care, 2012

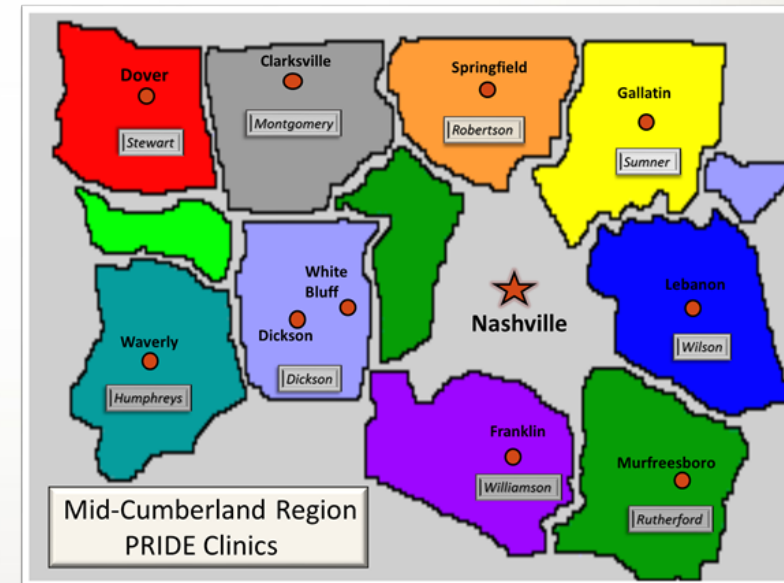
# Lesson #2

- Addressing health literacy/numeracy often involves addressing broader issues of health communication
  - Shared goal setting; shared decision making
  - Patient-Centered Communication
  - Cross-cultural communication
  - Beliefs/Heuristics

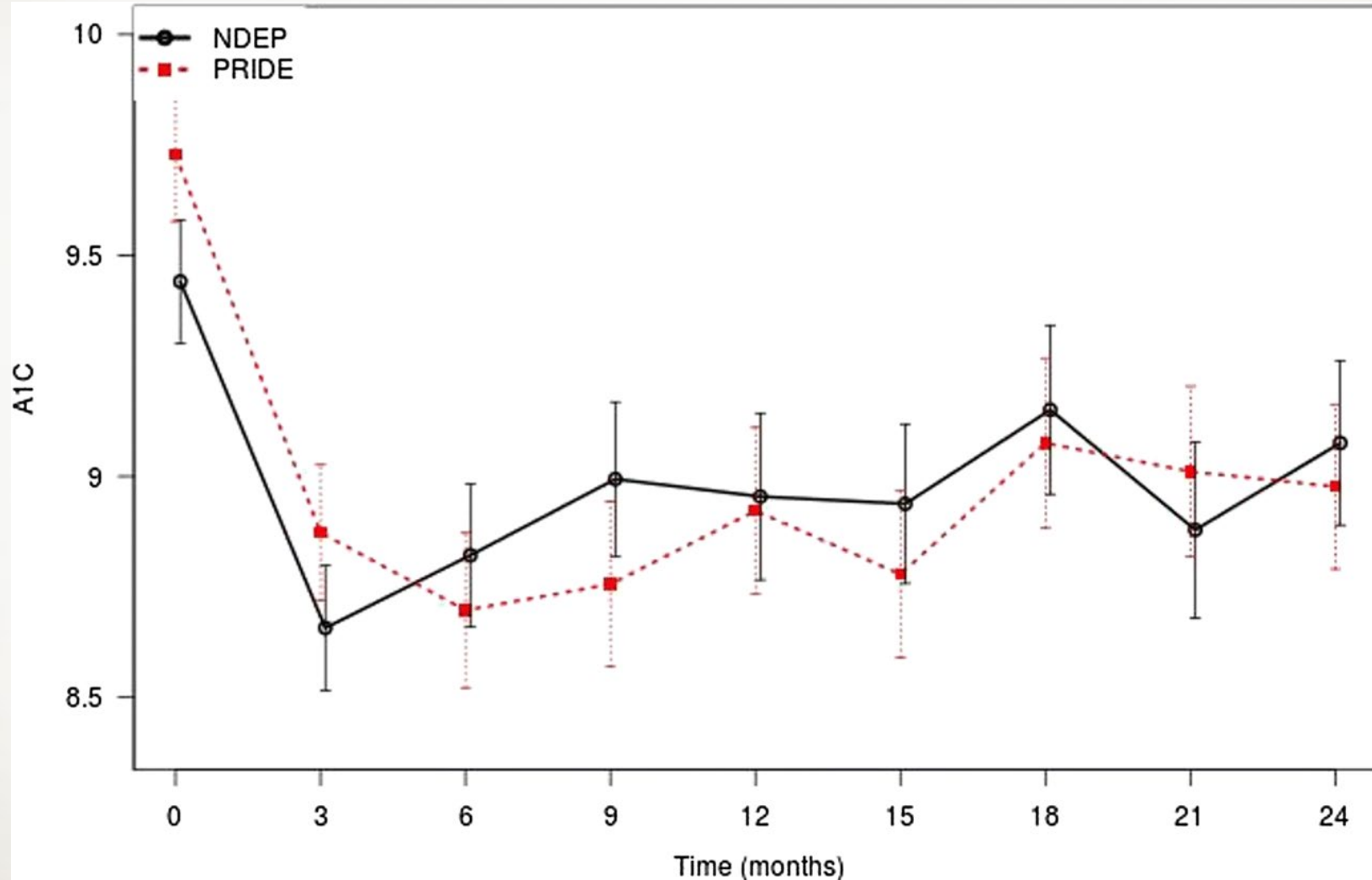
# PRIDE Study



- PaRtnering to Improve Diabetes Education
- Goal to address health communication issues to improve diabetes care in middle TN
- Collaboration between TN Dept. of Health, Vanderbilt, and Meharry
- 5 year NIDDK R18 study
- Cluster RCT with 10 Clinics and 400 diabetes patients
- Develop a sustainable model for improved diabetes care

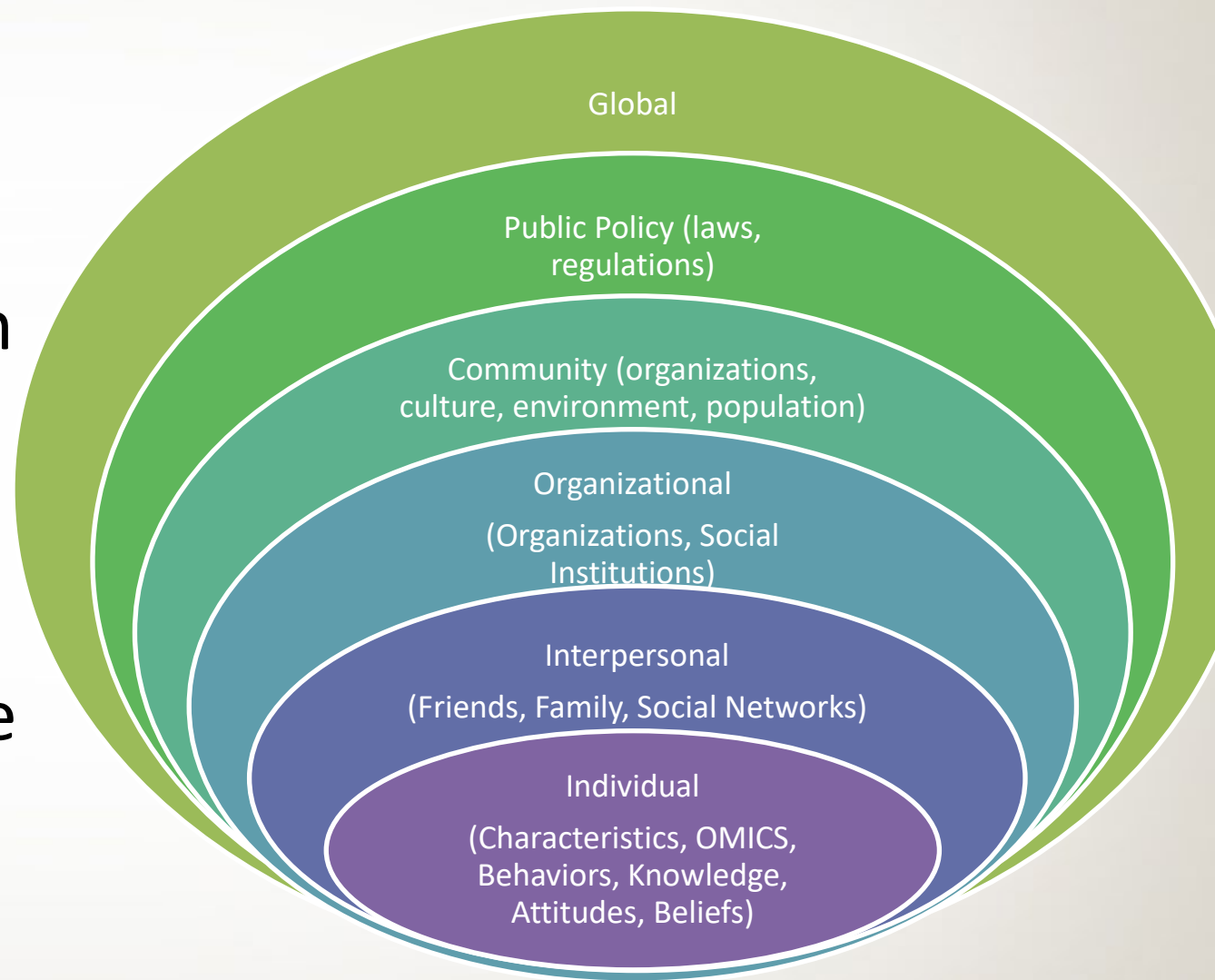


# PRIDE RESULTS



## Lesson #3

- Health Literacy/Numeracy and Health Communication are just one social determinant of health
- Successful interventions often need to consider the broader socioecological context and other barriers/facilitators to care



# Greenlight Study



- NIH (NICHD) Funded R01
- **Design:** Cluster Randomized Trial of Literacy Sensitive Obesity Prevention intervention vs Active Control (Injury Prevention)
- **Setting:** 4 academic primary care resident clinics (Vanderbilt, NYU, UNC, and U Miami)
- **Participants:**
  - Over 400 pediatric residents at the 4 sites
  - 865 English and Spanish speaking families with children enrolled at 2 months of age and followed until 2 years of age
  - Children with weight/length z score >3% (WHO Criteria) without significant chronic health issues or FTT or history of prematurity (<35 weeks)



# Study Design

- **Intervention**

- Training of residents in effective health communication
- Provision of Greenlight Toolkit to use at well child visits (2,4,6,9,12, 15/18, 24 months)

- **Active Control**

- Training of residents in injury prevention
- Use of AAP Training in Injury Prevention Program (TIPPs) to use at well child visits

**Keep Your 2 Month Old Growing Healthy!** 

**Learn how your baby shows you he's hungry or full.**  
So you give the right amount - not too much and not too little!  
pages 2-4

**Breast milk or formula is best.**  
Your baby does not need juice or solid foods.  
pages 5-9

**Put your baby on her tummy to play every day.**  
Help keep your baby growing strong!  
pages 10-11

  
2 Month Core Booklet - English

**Keep Your 4 Month Old Growing Healthy!** 

**Learn how your baby shows you he's hungry or full.**  
So you give the right amount - not too much and not too little!  
pages 2-3

**Wait to start solid foods.**  
Most babies are not ready until they are close to 6 months old.  
pages 9-11

**Breast milk or formula is best.**  
Your baby does not need juice.  
pages 4-8

  
4 Month Core Booklet - English

**Keep Your 6 Month Old Growing Healthy!** 

**Start solid foods the right way.**  
Give healthy foods - and the right amount - from the start!  
pages 2-7

**Be active with your baby.**  
Put her on a blanket on the floor with some toys and play together!  
page 11

**Breast milk or formula are the only drinks your baby needs.**  
Your baby does not need juice.  
pages 8-10

  
6 Month Core Booklet - English

**Keep Your 9 Month Old Growing Healthy!** 

**Give your baby small amounts of healthy, soft "finger foods."**  
Your baby is learning to feed himself!  
pages 2-6

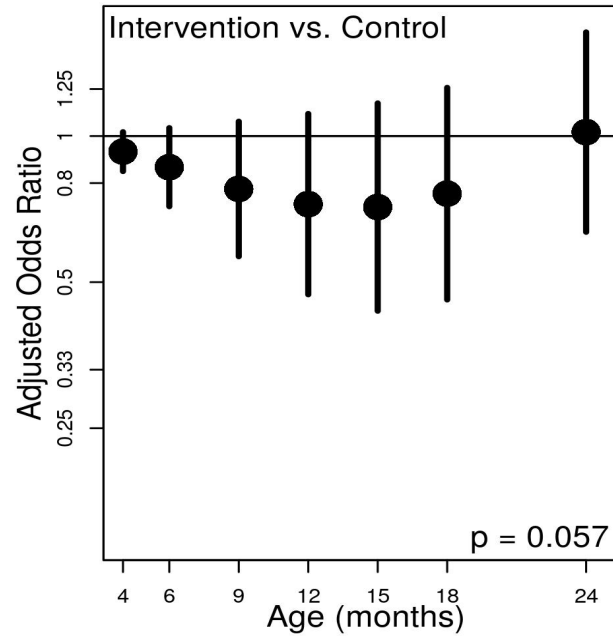
**Join your baby on the floor for active play time.**  
TV time is not active time.  
page 11

**Breast milk, formula and water are best.**  
Your baby does not need juice or other sugary drinks.  
pages 7-10

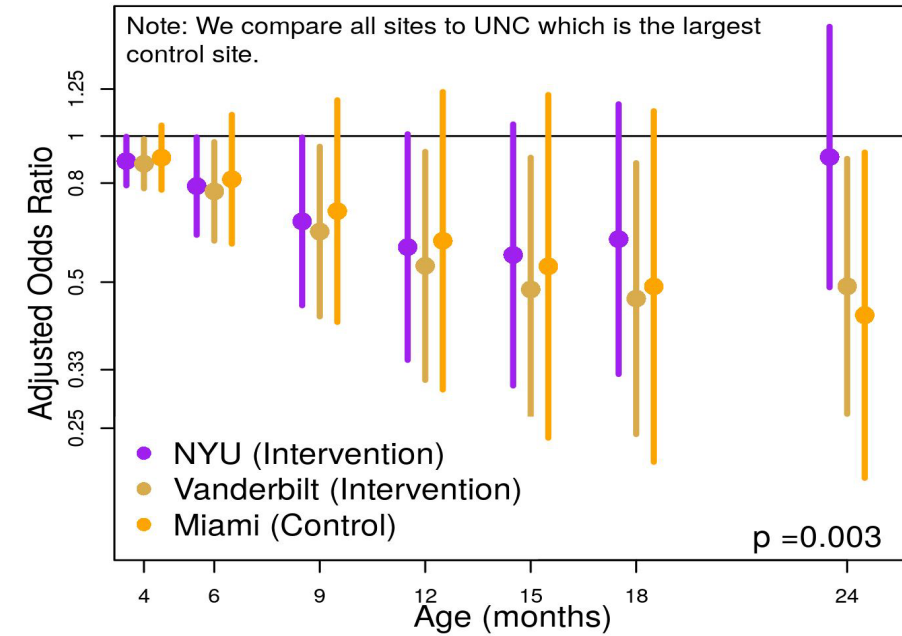
  
9 Month Core - English

# GREENLIGHT MAIN RESULTS

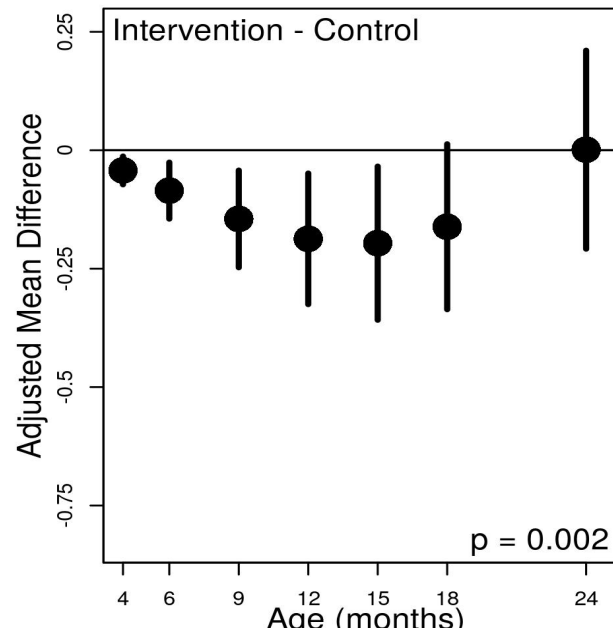
BMI  $\geq$  85th Percentile



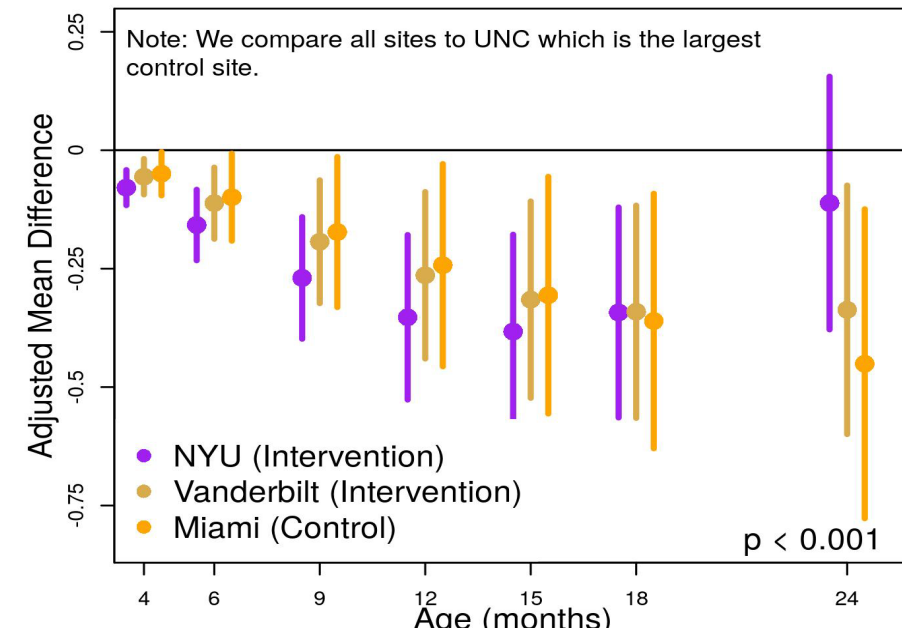
BMI  $\geq$  85th Percentile



BMI Z Score



BMI Z Score



*Pediatrics, 2021*



# Greenlight Plus: A Multi-Site RCT

The Greenlight Program for Early Childhood Obesity Prevention

Co-Principal Investigators:

Alan Delamater PhD, Kori Flower MD MS MPH, William Heerman MD MPH, Eliana M. Perrin MD MPH, Lee M. Sanders, H. Shonna Yin, MD MS, Russell L. Rothman MD MPP



# Intervention Content

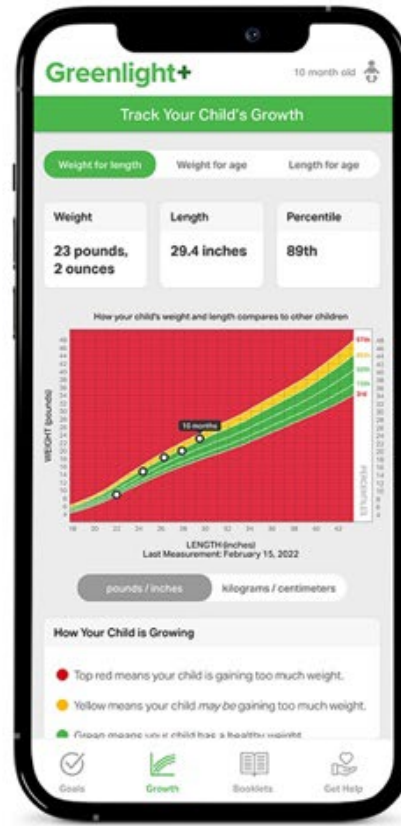
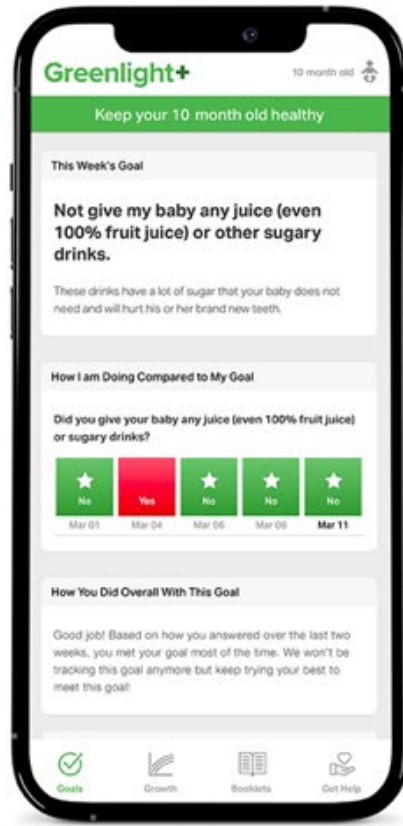
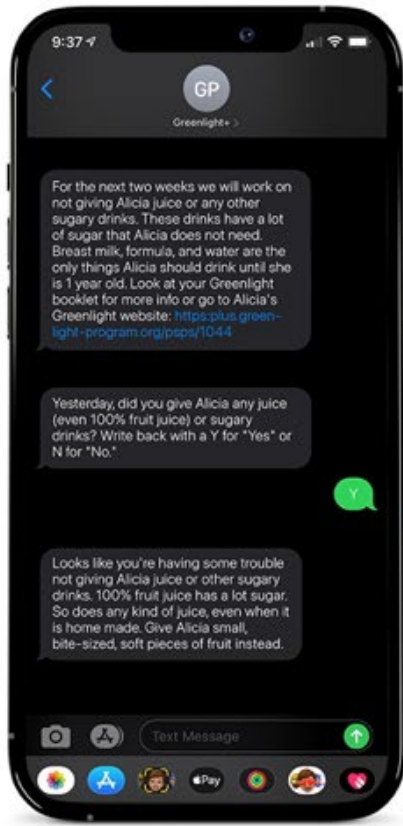
- The “Greenlight” group received health behavior counseling delivered by pediatric primary care clinicians.
- It was a health communication intervention designed to support pediatric primary care providers in delivering anticipatory guidance around health behaviors to parents of children from birth to age 2 years with the goal of obesity prevention.
- The materials included eight core booklets.



# Intervention Content

- The Greenlight Plus” group included the health behavior counseling plus two digital intervention strategies: an interactive, responsive text messaging intervention and a web-based dashboard.
- The text messaging portion of the intervention used behavior change techniques such as facilitated goal-setting, self-monitoring, and tailored feedback around developmentally appropriate health behaviors known to support healthy child growth
- Goals were organized into two-week cycles, where a goal was set on the first day of the cycle, followed by five automated check-in messages over two weeks. Parents were asked to self-rate their goal progress.
- A fully-automated system then provided immediate adaptive feedback, tips, and encouragement based on goal progress. After the first six months, the content of goal cycles was tailored based on a parent’s response to a survey every three months that assessed readiness to change and self-efficacy for specific health behaviors

# Digital Intervention Content



# Multi-Site RCT (N=900) to compare the effectiveness of Greenlight vs Greenlight Plus



**Greenlight** 15-18 MONTHS  
First steps to growing healthy

**HEALTHY EATING**  
Page 4

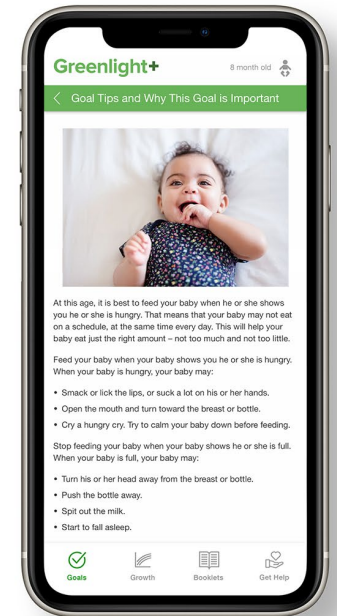
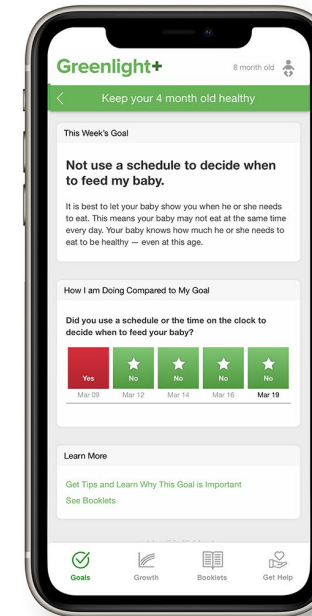
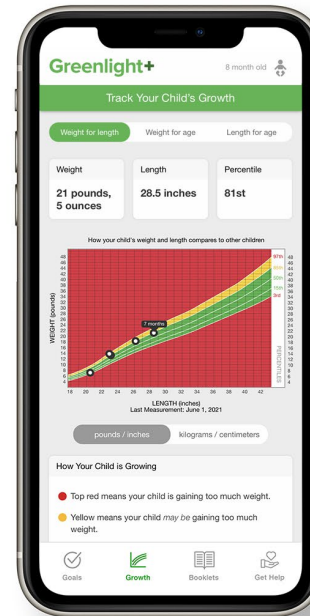
**HEALTHY DRINKS**  
Page 13

**ACTIVE PLAY**  
Page 17

**Choose healthy foods and give the right amount.**  
Let your child decide how much she needs to eat.

**Milk and water are best.**  
Your child does not need juice or other sugary drinks.

**Be active with your child – without screens.**  
Screen time is not active time.



**Greenlight:** Everyone Gets Booklets  
Resident Training

**Greenlight Plus:** Get Greenlight plus Text messages and mobile dashboard



# Outcomes and Analysis

- The **primary outcome** was **child weight-for-length (kg/m) trajectory over two years.**
- Secondary Outcomes
  - Weight-for-length z-score trajectory,
  - BMI z-score,
  - the percent of children at the 24-month follow-up overweight and/or obesity (both CDC and WHO curves).
- Nested linear mixed effects models (random intercepts and slopes for clinics and participants within clinics).
- Models adjusted for prespecified baseline variables to enhance precision: child birthweight and biological sex, parent reported race and ethnicity, health literacy, preferred language, education level, annual household income and household food insecurity
- Pre-specified heterogeneity of intervention effect analyses

# Lesson #4

- Health Communication is an iterative process
- Relies on communication between patients, families, providers, social media, and other sources of information
- Need to consider the role of digital media and “asynchronous” communication
- Focus on communication that promotes knowledge, trust, and behavior change

# Summary

- Health Literacy is a complex skills
- Health Literacy is one component of the larger socioecological landscape
- Interventions need to consider multi-modal and iterative forms of communication

# Acknowledgements

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  - Elaine Galland RD, Benard Dreyer, MD
  - Alan Mendelsohn, MD
- Duke
  - Adrian Hernandez MD, Matt Roe MD, Schuyler Jones
  - Ian Sanderson MD, Ebony Boulware MD (Wake)
  - Gene Oddone MD, Lauren Cohen
- UNC
  - Tim Carey MD MPH, Michael Kappelman MD
  - Eliana Perrin MD MPH (now Hopkins)
  - Joanne Propst-Finkle JD, Alice Ammerman PhD RD
  - Michael Pignone MD MPH (now Duke), Darren DeWalt MD MPH, Morris Weinberger PhD, John Buse MD PhD CDE
  - Robb Malone PharmD CDE, Betsy Bryant PharmD CDE, Victoria Hawke RD, Britton Crigler BS, James Joyner BA
- Health Sciences of South Carolina
  - Katrian Fryar, Les Lenert MD (MUSC), Ken Deans (HSSC)
- Miami/Stanford
  - Lee Sanders MD MPH, Alan Delamater PhD
  - Anna Maria Patino Fernandez, PhD
  - Daniela Quesada, MPH, Vivian Franco MPH, Sheah Rarback, RD, Sarah Messiah, PhD, Lourdes Forster, MD
- Wake Forest
  - Gary Rosenthal MD, Brian Ostasiewski
- Mayo
  - Veronique Roger MD, Alanna Chamberlain PhD
- Essentia
  - Stephen Waring DVM PhD, Catherine Benziger MD
- Stanford University
  - Ken Mahaffey MD, Tina Broussard-Hernandez PhD
- TDOH
  - Cathy Taylor RN PhD, Lori MacDonald MD MPH, Laura Harris RD CDE



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YOU



Russell Rothman, MD, MPP



[russell.rothman@vumc.org](mailto:russell.rothman@vumc.org)

<https://www.vumc.org/medicine-public-health>