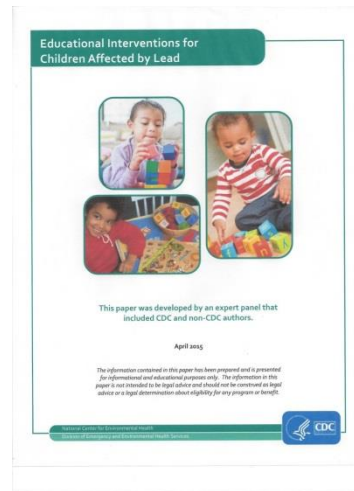


Educational Interventions for Children Affected by Lead



A Summary of Recommendations from
CDC's 2015 Expert Panel

Pat McLaine, DrPH, MPH, RN

October 18, 2017

Childhood Lead Exposure: a critical public health issue

- Tens of millions of US children adversely affected by lead in last 20 years – lifelong effects
- Lead exposures continue: from deteriorated paint, dust, soil, water, air and other sources
- Once child's cognition harmed, effects can be permanent and continue to adulthood
- Effects are costly: more than \$50 billion/year in reduced cognitive potential and lost productivity

Other considerations

- Clear evidence of the impact of BLL in early childhood on later academic performance
- Excellent evidence for providing optimal educational environment for young children
- Poor understanding of how community lead exposure affect community educational outcomes
- No clarity on extent to which Federal requirements for education could be used to ensure access to educational services for lead exposed children

Many Unanswered Questions

- Does education make a difference?
 - Some evidence for neurological impairments similar to lead
 - No studies of intervention with children previously exposed to lead
 - Early intervention – clear cost benefit

Charge of the Workgroup

- Compile existing evidence of neurodevelopmental and cognitive impact of lead
- Summarize Individuals with Disabilities Education Act (IDEA) – Parts B and C
- Identify how provisions of IDEA relate to children affected by lead
- Describe specific action steps to ensure that children affected by lead receive timely and appropriate educational interventions

Expert Panel

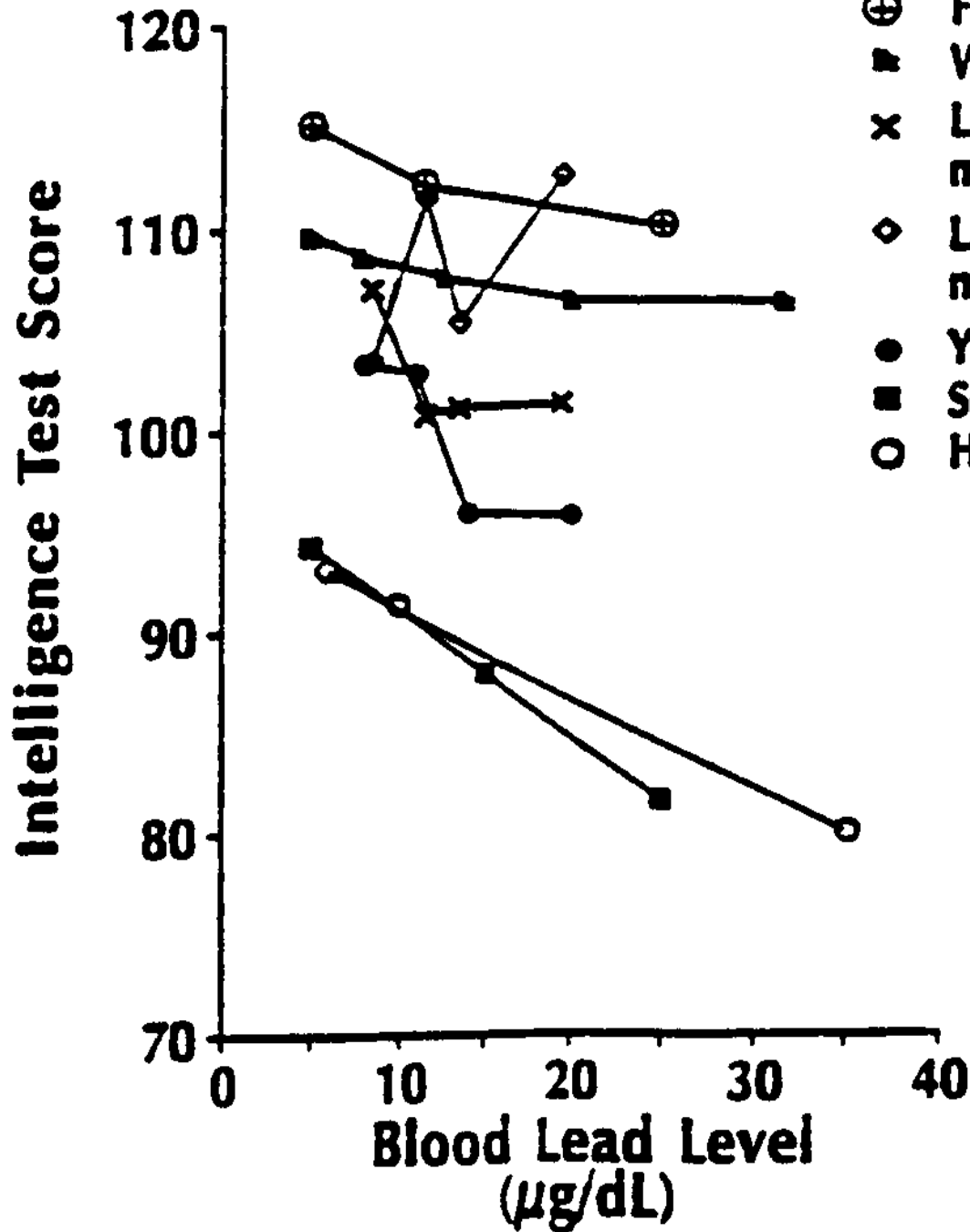
- Sher Lynn Gardner, MD, FAAP
- Mary Jean Brown, ScD, RN
- Cassandra Archie
- Helen J. Binns, MD, MPH
- Vivian Cross, PhD (deceased)
- Kim N. Dietrich, PhD, MA
- Sue Gunderson
- Valarie Johnson
- Linda Kite
- Jane Malone
- Pat McLaine, DrPH, MPH, RN
- Reghan O. Walsh
- Dana Williams
- Pongsuda Rattanamasongkol, EdS, RN

Wide range of expertise

- Worked with Childhood Lead Poisoning Prevention Programs (CLPPPs)
- Parent and child advocates
- Academics and researchers
- Health care providers
- Educators
- Lead poisoning prevention and policy advocates
- Special education consultants
- Lead in housing experts
- Geographic representation

Lead and Cognitive Effects

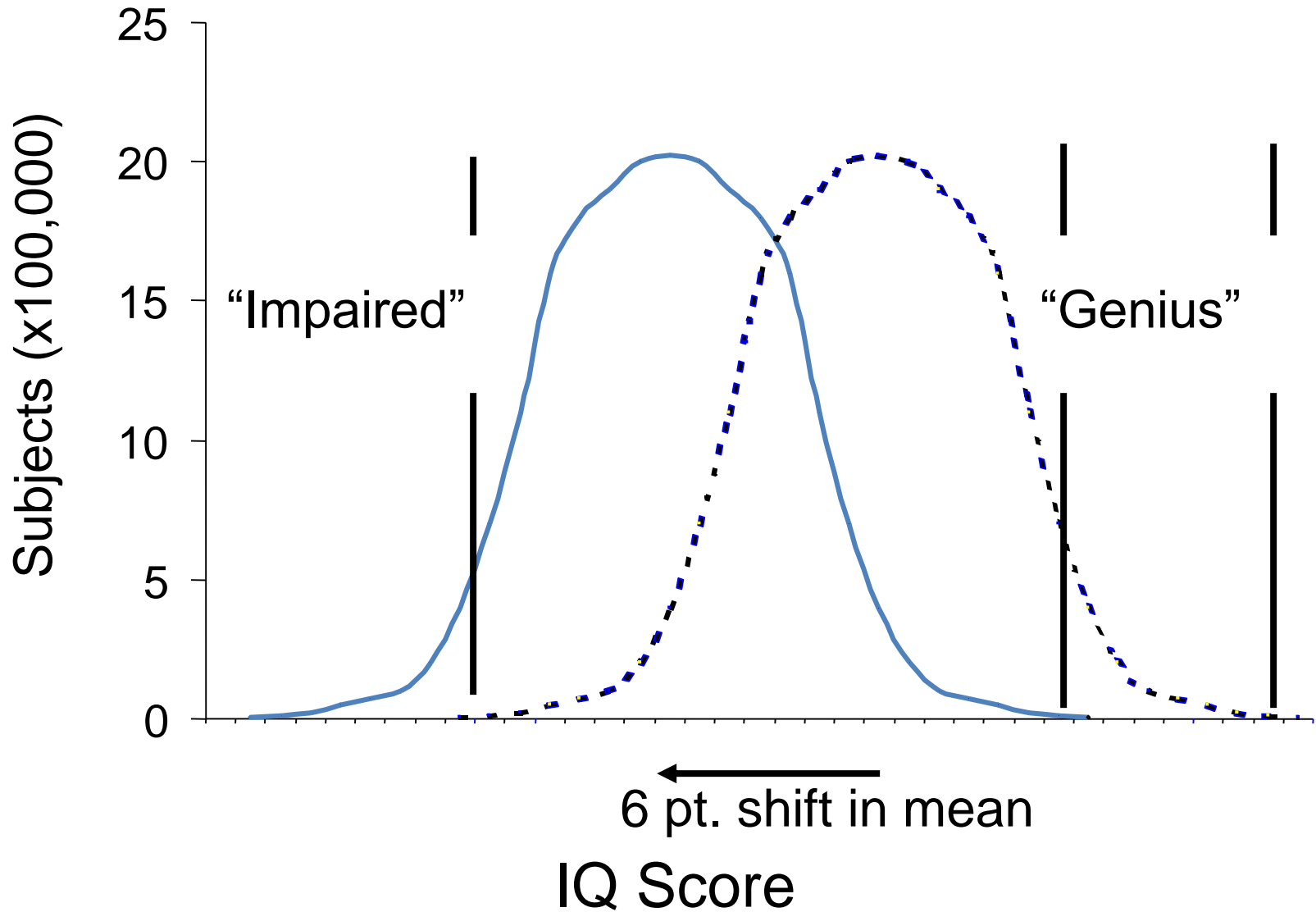
- Lead associated cognitive effects in children
 - Decreased IQ
 - Decreases in visual-spatial skills, cognitive flexibility, working memory
 - Poor school performance
 - Lower scores on end of grade exams (reading, math)
 - Failure to graduate from high school
 - Reading disability
 - Increased attentional dysfunction
 - Increased aggression
 - Increased delinquency
- Early deficits may persist.
- No threshold.



- ⊕ Fulton et al. (1987)
- WHO/CEC (Winneke et al., 1990)
- × Lansdown et al. (1986), manual occupation
- ◇ Lansdown et al. (1986), non-manual occupation
- Yule et al. (1981)
- Schroeder et al. (1985)
- Hawk et al. (1986)

Association
Between IQ
Scores & Blood
Lead Levels
in Children

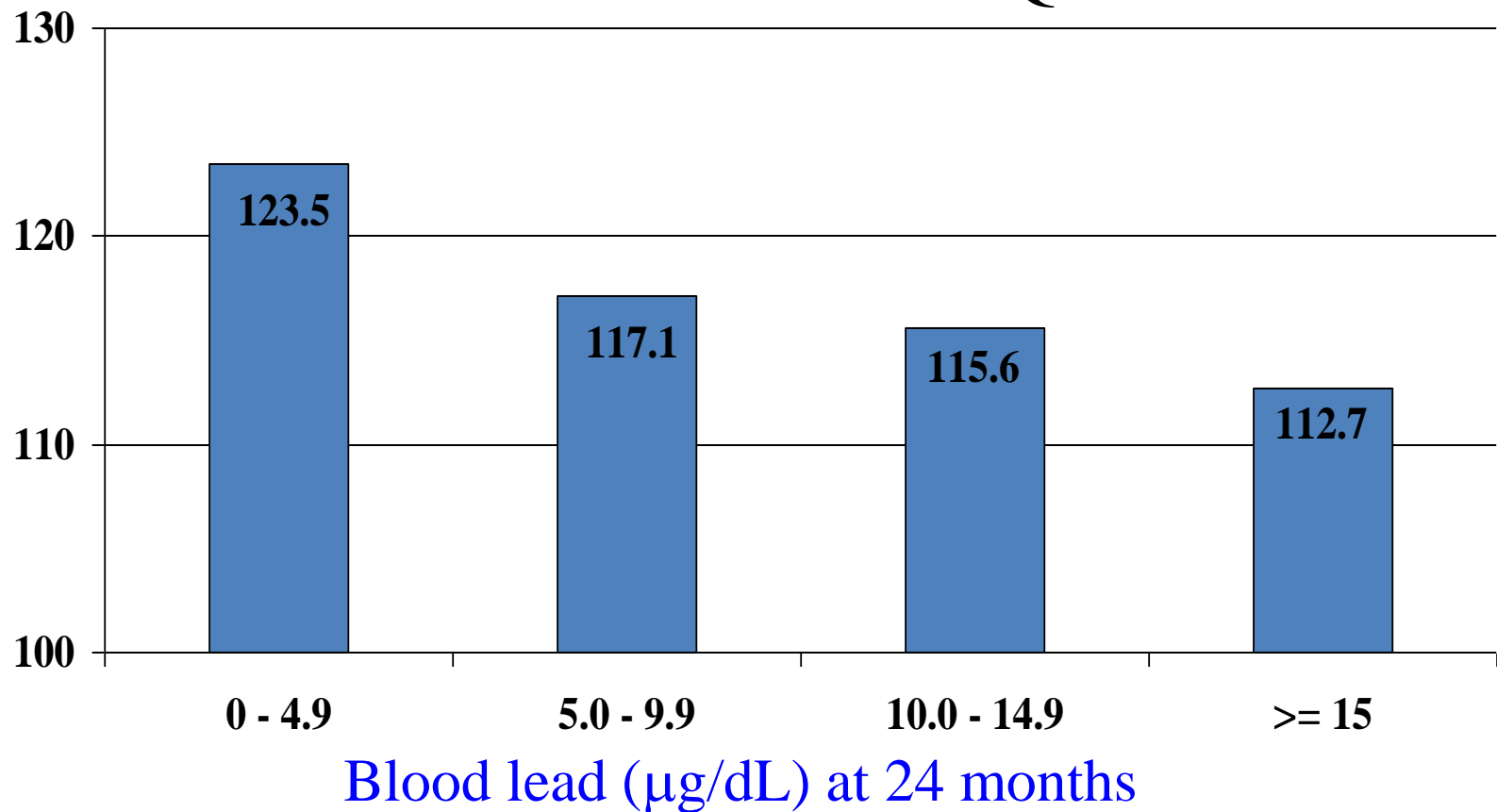
Significance of IQ Deficit



Low Level Exposure and Cognitive Function

Adjusted
Score

WISC-R Full Scale I.Q. Scores



Bellinger. *Pediatrics* 1992;90:855-891

Effects of Blood Lead <5 µg/dL on Standardized Tests

NHANES III, n=4,853, ages 6-16 years

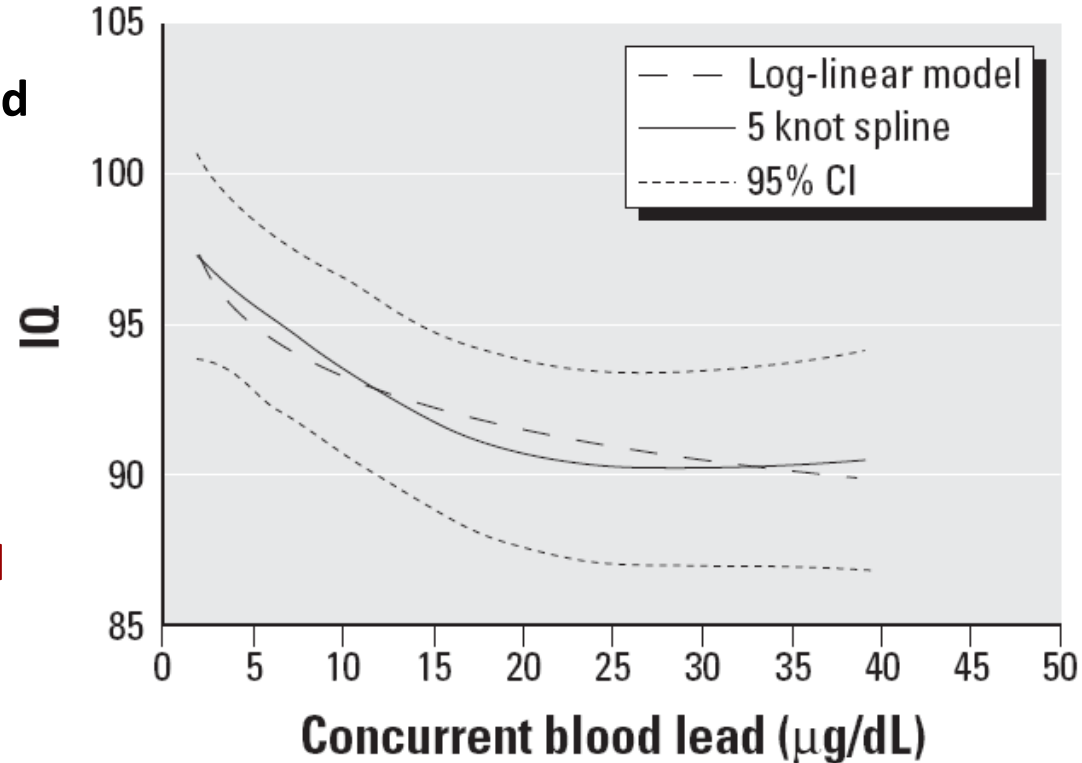
Current Blood lead	Math Test Adjusted mean	Reading Test Adjusted mean
≤1 µg/dL	95.8	94.5
1.1-1.9 µg/dL	94.0	93.3
2.0-3.0 µg/dL	94.7	93.0
>3.0 µg/dL	91.4	88.2
	p<0.0001	p<0.0001

Blood lead and IQ in children – International pooled analysis

■ Estimated IQ decrements estimated with increases in blood lead from:

- 2.4 to 10 $\mu\text{g}/\text{dL}$: 3.9
- 10 to 20 $\mu\text{g}/\text{dL}$: 1.9
- 20 to 30 $\mu\text{g}/\text{dL}$: 1.1

→ Steepest declines were at blood lead levels $<10 \mu\text{g}/\text{dL}$

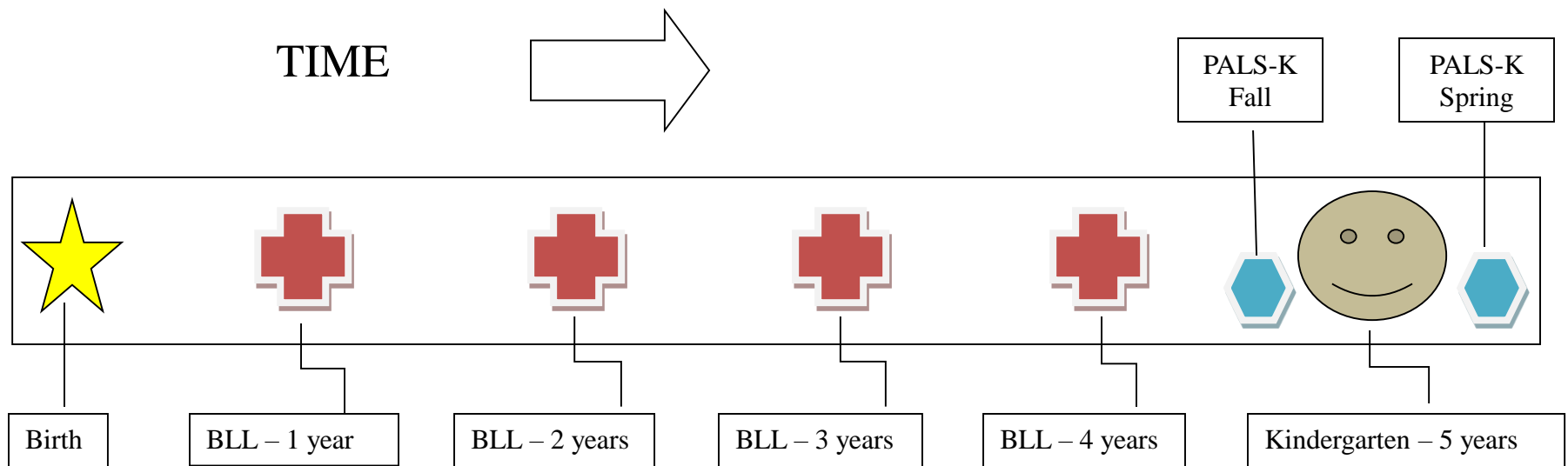


Focus on Reading

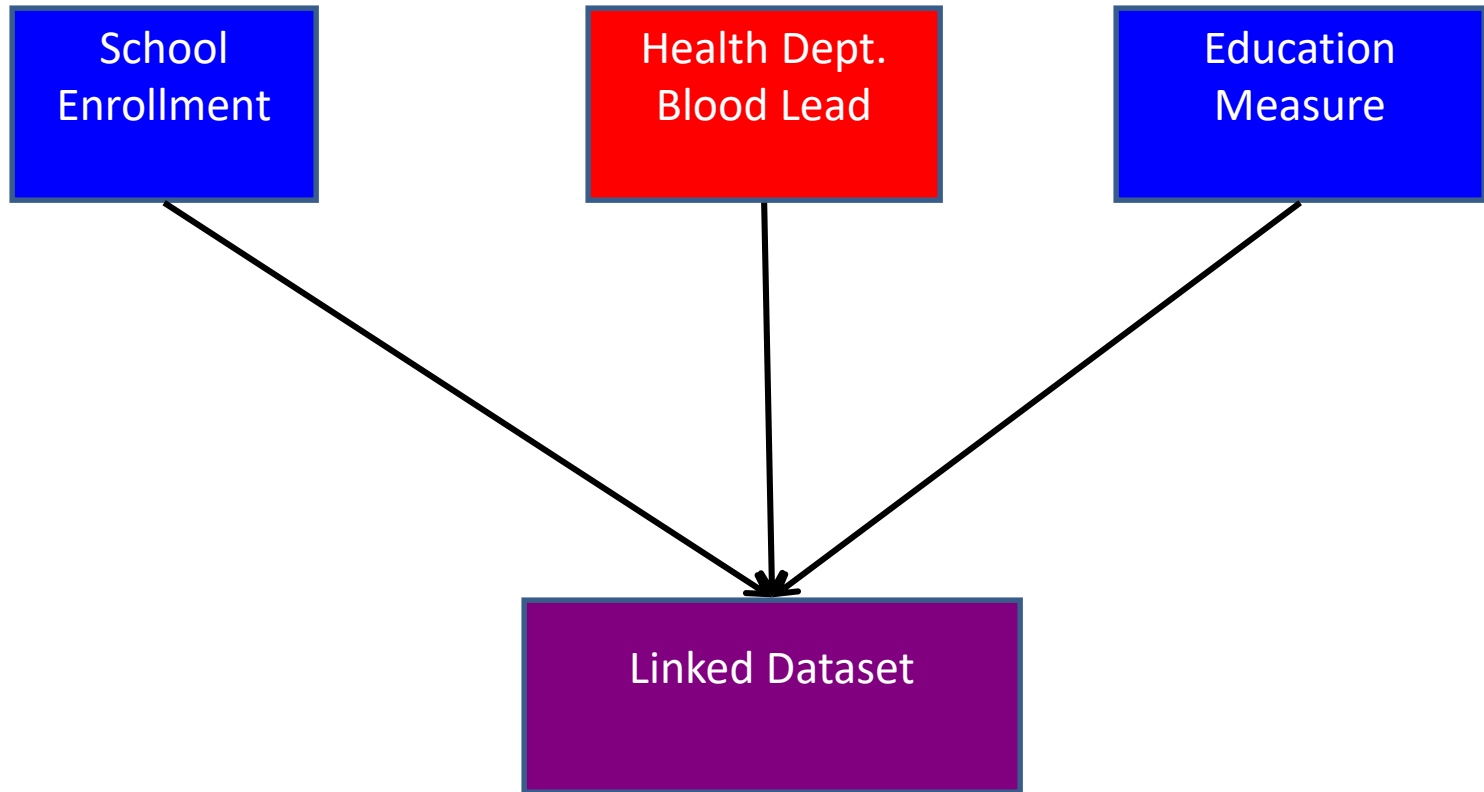
- About 25% of US children enter kindergarten not ready to learn to read
- Reading readiness predicts
 - success in school
 - later employment opportunities
- **Early** educational intervention is more effective
 - 80% if before 3rd grade
 - 10-15% if after 5th grade

Studies of Lead and Educational Outcomes

Based on ability to link **individual** measures of blood lead exposure in early childhood with individual measures of reading, math, reading readiness at a later time

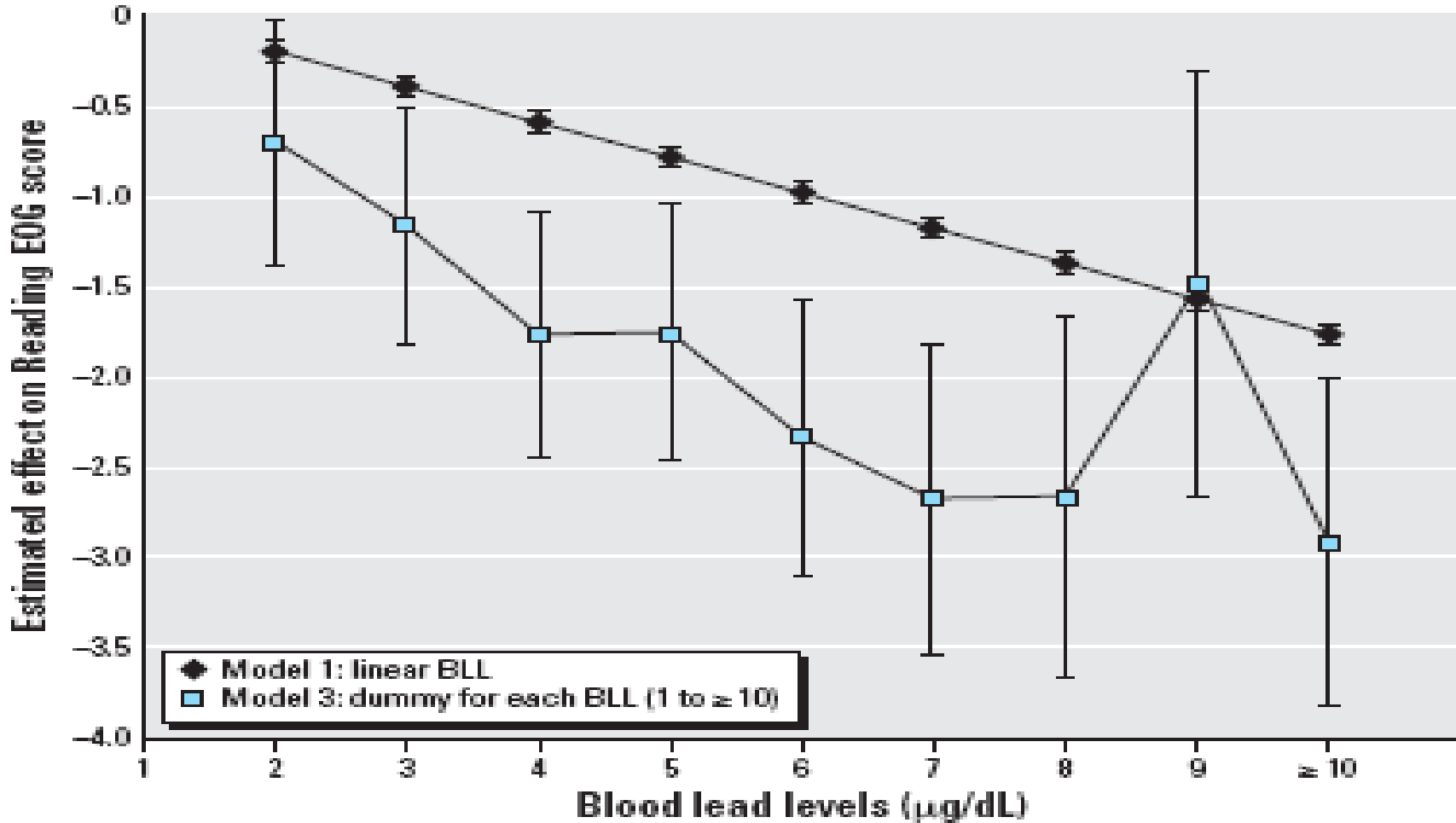


Data Sources



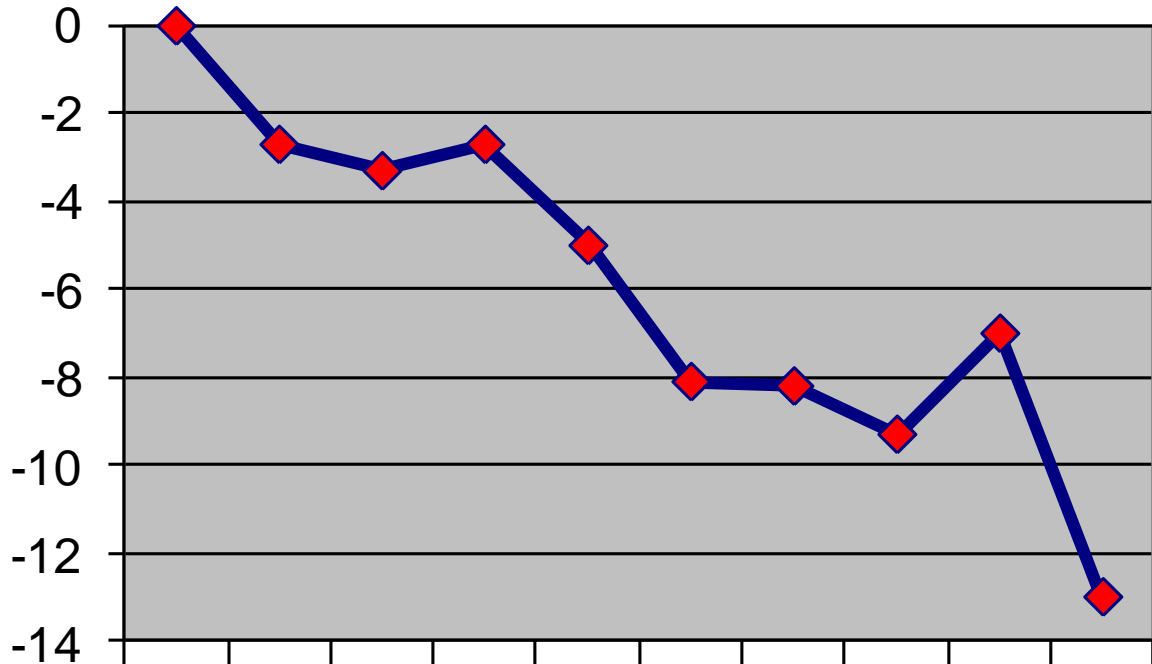
Lead and Reading Scores

~8,600 children



Differences in Mean Fall PALS-K Scores between Refined GM BLL Category & Reference Category

Difference in Adjusted Mean Fall PALS-K Score



GM BLL Category

Difference in Adjusted Mean Fall PALS-K Score	Ref.	-2.7	-3.3	-2.7	-5	-8.1	-8.2	-9.3	-7	-13
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Achieving Benchmark Standards Reading Readiness – Kindergarten

GM BLL Group

Prevalence Ratio

(95% CI)

Children with BLL 0-4 μ g/dL	1.00	Reference
Children with BLL 5-9 μ g/dL	1.21	(1.19, 1.23)
Children with BLL 10+ μ g/dL	1.56	(1.51, 1.60)
		p trend = <0.001

Model adjusted for: lead, age at start of kindergarten, year, sex, race, child language, free/reduced lunch status

Lead and Educational Outcomes - $<5\mu\text{g}/\text{dL}$

Blood Lead Levels	Educational Impact	Size of Study	Location of Study
$\leq 3 \mu\text{g}/\text{dL}$	Decreased end of grade test scores	More than 57,000 children	North Carolina (Miranda et al. 2009) ¹
4 $\mu\text{g}/\text{dL}$ at 3 yrs old	Increased likelihood learning disabled classification in elementary school	More than 57,000 children	North Carolina (Miranda et al. 2009) ¹
	Poorer performance on tests	35,000 children	Connecticut (Miranda et al. 2011)

Lead and Educational Outcomes – 5-9 μ g/dL

Blood Lead Levels	Educational Impact	Size of Study	Location of Study
5 μ g/dL	30% more likely to fail third grade reading and math tests	More than 48,000 children	Chicago (Evens et al. unpublished data)
	More likely to be non-proficient in math, science, and reading	21,000 children	Detroit (Zhang et al. 2013)
5-9 μ g/dL	Scored 4.5 points lower on reading readiness tests	3,406 children	Rhode Island (McLaine et al. 2013)

Lead and Educational Outcomes – 10-19 $\mu\text{g}/\text{dL}$

Blood Lead Levels	Educational Impact	Size of Study	Location of Study
$\geq 10 \mu\text{g}/\text{dL}$	Scored 10.1 points lower on reading readiness tests	3,406 children	Rhode Island (McLaine et al. 2013)
10 and 19 $\mu\text{g}/\text{dL}$	Significantly lower academic performance test scores in 4th grade	More than 3,000 children	Milwaukee (Amato et al. 2012)

Lead and Educational Outcomes – 25+ $\mu\text{g}/\text{dL}$

Blood Lead Levels	Educational Impact	Size of Study	Location of Study
$\geq 25 \mu\text{g}/\text{dL}$	\$0.5 million in excess annual special education and juvenile justice costs	279 children	Mahoning County, Ohio (Stefanak et al. 2005)

Reference: Education Services for Children Affected by Lead Expert Panel. Educational interventions for children affected by lead. Atlanta: U.S. Department of Health and Human Services; 2015; page viii (Table 1. Studies on Lead and Educational Outcomes).

Identifying Developmental Delays

- Young child may not have “delay” – but effects may present later
- Long term surveillance of behavior and neurodevelopment is needed
 - Annual by PCP
- Changes may be identified during critical transition points
 - 1st, 4th, 6th grades

Child Educational Development - 1

- Preschool – listening, attention, social and emotional skills
- Early Elementary (K-3) – learning to read, learning basic math skills
- Upper Elementary (4-5) – reading to learn, increased social networks and physical challenges (balance)

Child Educational Development - 2

- Middle School (grades 6-8) – more formal academic structure, requiring higher order cognitive and organizational skills, executive functioning and impulse control, more academic problems, dropping out
- High School (grades 9-12) – more rigorous and disciplined environment, requiring good study and organizational skills; poor grades, poor reading skills, increasing failure to graduate

Enriched/Nurturing Environment

Animal Studies

- Stimulation and exercise improve behavior and learning
 - Toys
 - Exercise wheels
 - Other rats
- Improvements associated with changes in:
 - Brain size, weight, structures
 - Changes in neuro-circuitry
 - Increases in synaptic plasticity
- Continuous exposure to enriched environment necessary to maintain gains

Human Studies

- Stimulation, higher SES and increased environmental control improve academic performance.
 - Books and materials
 - Parent involvement
 - Nurturing relationships
- Stress associated with decreased brain size, structures
- School intervention for poor readers associated with changes in brain neuro-circuitry
- Reading interventions must continue during vacation to maintain progress

Knowledge Gaps

- Contribution of early education
 - Clearly makes a difference for at-risk children (\$3-7 savings for every dollar spent)
 - Significant improvements documented for children with autism and developmental disorders
- If/how specific educational programs make a difference
 - No studies
 - For reading disability, individual approach appears to work best
- If supporting parents and improving their parenting skills would improve outcomes
 - No studies - might help

Urban School Districts: Challenges Underestimated

- The extent of lead exposure risks for urban children is not well understood.
- Urban children from higher income families may attend private/parochial/charter schools
- Population of children remaining in public schools often at higher risk for poor educational outcomes:
 - Lower income
 - Poor housing
 - Higher proportion of children with lead exposure history

Prevalence of BLLs $\geq 10\mu\text{g}/\text{dL}$ among Providence kindergarten students



- Much higher than national estimates
- 20% - one in five - had at least one BLL $\geq 10\mu\text{g}/\text{dL}$.
- NHANES 1999-2004: 1.4% of 1-5 year olds had BLL $\geq 10\mu\text{g}/\text{dL}$.

How many children affected by lead now attend Rochester Public Schools?



- Once in school, the burden of early lead exposures may be invisible
- Lead exposure may account for significant proportion of children with poor academic progress
- If you don't know about a child's lead exposure, you may not be able to provide appropriate educational services.

Individuals with Disabilities Education Act

IDEA

- Provides federal funds and oversight for
 - early intervention
 - special education and
 - related *services*
- Part B - Child Find – identifies children 0-21
 - Programs must coordinate with MCH, EPSDT, Head Start, Early Head Start, and SSI Programs
 - Resources include parent centers and community parent resource centers
- Part C Early Intervention Program – children 0-3

IDEA – Part C – Early Intervention for Infants and Toddlers with Disabilities

- Child is less than 3 years of age
- Child needs early intervention services:
 - Is experiencing developmental delays in one or more areas (cognitive, physical, communication, social/emotional, or adaptive development) or
 - Has diagnosed condition of established risk that has high probability of resulting in developmental delay
- States have discretion to provide services to children who are at-risk for substantial delays if they do not receive early intervention services
- States can extend services until elementary school
- Child less than 3 with lead exposure may not yet have delay

Part C Eligibility (2012) for children with lead exposure

- Eight states mention lead exposure as eligible condition for services or tracking (exposure or exposure plus poor educational performance)
- 12 more states specify BLL thresholds as criteria ($>10\mu\text{g}/\text{dL}$ to $>45\mu\text{g}/\text{dL}$)
- 13 more states **including New York** mention non-specific “toxic” exposures
- No specific definition for lead poisoning in Federal statute or regulation

Eligibility for IDEA Part B

- Child has identified disability and needs special education and related services
- Child age 3-9 years experiencing developmental delays and needs special education and related services
- Developmental Delays:
 - Physical development
 - Cognitive development
 - Communication development
 - Social or emotional development
 - Adaptive development

Definitions of Disability – IDEA Part B

- Autism
- Deaf-blindness
- Deafness
- Emotional disturbance
- Hearing impairment
- Mental retardation
- Multiple disabilities
- Orthopedic impairment
- Other health impairment

“Other health impairment”
is due to chronic or acute
health problems including
lead poisoning **and**
adversely affects a child’s
educational performance

Part B – Special Education for children 3-21 years of age

- Child identified
- Child evaluated
- Eligibility for special education is decided
- If child is determined to be eligible for services
 - Individualized education program (IEP) team including parents meet, prepare IEP
 - Services provided
 - Progress measured and reported through report card or as requested by parents
- IEP reviewed annually
- Child reevaluated at least every 3 years

IDEA: Part B

Are children affected by lead eligible?

- YES, if child
 - Has one or more of 13 listed IDEA disabilities including “other health impairment”
 - Needs special education
 - At age 3-9 is experiencing developmental delay as defined by state
- NOTE: the condition must adversely affect the child’s educational performance

IDEA: Part B

- Section 619 Preschool - children 3-5 with same conditions as Part B
- Coordinated Early Intervening Service (CEIS) - Non-special education services for K-12 children
- Two intervention models:
 - Response to Intervention for children who are struggling academically
 - Positive Behavioral Support for children with problem behaviors
 - Could be used to develop monitoring plan to address needs of lead affected students with reading, math, behavioral problems but not ID with disability

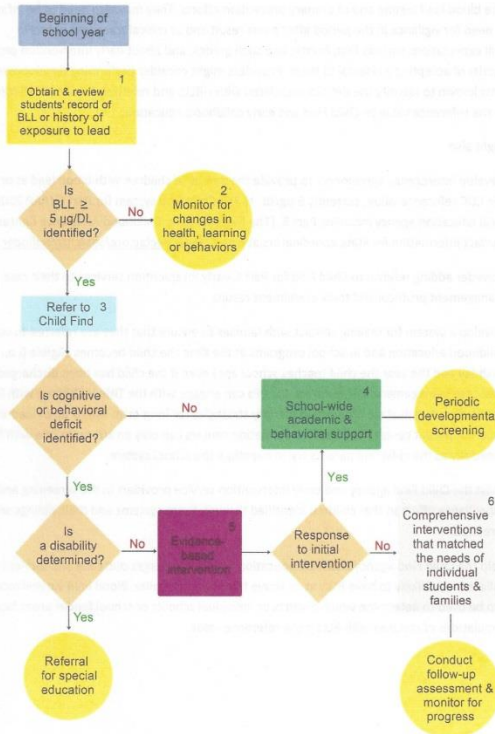
Rehabilitation Act of 1973, Section 504: Federal Civil Rights Protections

- Services for children with disabilities who are not eligible for IDEA
- Requires schools meet specialized needs of children with disabilities and provide access to same resources provided to children without disabilities
- Targets individuals with physical or mental impairment that substantially limits a major life activity: walking, seeing, hearing, thinking, reading, learning, concentrating
- Child does not need to qualify for special education

Decision Chart

Educational Interventions for Children Affected by Lead

Figure 3: Decision Chart for Children Affected by Lead



Guidance from Connecticut: pre-school

- Incorporates Child Find, immediate interventions with PCP, housing, school nurse, school team
- Actions dependent on existence of risk factors (yes or no) and noted or suspected developmental delays
- Child with BLL $5\mu\text{g}/\text{dL}$ or above and no risk factors receives monitoring plan with annual review and referral to enrichment program

Guidance from Connecticut: K-12

- Uses Child Find, multiple referral sources
- Immediate interventions include PCP, housing assistance, school nurse, school team
- Intervention based on length of exposure, risk factors, existence of developmental delay or disability
- Minimal intervention includes monitoring plan, follow in Scientific Research-Based Intervention Framework (especially for attention, executive function, language, behavior), annual review, after-school enrichment program

Educational Follow-up

- Local education agencies can ensure that children affected by lead are identified, assessed and receive educational support.
- If lead exposure is not identified or tracked, problems at school may not receive appropriate response
- Some children are more affected at a given BLL and will require different interventions
- Keys to intervention:
 - Connecting children to early intervention services and early enrichment
 - Identifying delays at critical transition points
 - Intervene as early as possible

CDC Recommendations for Local Education Agencies

- Develop policies and procedures identifying services for children who may be affected by lead
- Request parents or PCPs provide results of all BLL tests and developmental assessments, keep confidential
- Ensure teachers know about children's lead exposure and monitor progress regularly
- Use Child Find for ID and early referrals
- Develop monitoring plan within Scientific Research-Based Intervention (SRBI) framework for students 3-21 affected by lead
- Educate school personnel about adverse affects of lead exposure on academic performance & behavior

CDC Recommendations for Local Education Agencies – cont.

- Refer students to Section 504 team for determination
- Collaborate with parent centers, parents, community partners
- Obtain census tract BLL data to identify populations at high risk for HBLLs – prioritize for referrals and resources
- Communicate with MCOs and PCPs about needs of children affected by lead

Overall Conclusions

- Lead exposure contributes to many disparities observed in educational settings.
- Eliminating exposures to lead hazards remains key.
- There is no “safe” level of lead.
- Data linkage approaches would benefit public schools and public health.
- Advocacy for resources and approaches that work is critical.
- Ensuring that all children with elevated BLLS receive the educational services they need will set the stage for a better future for individual children and the communities where they live.

Questions?



