



MINDS MATTER

Seeing Concussion Through New Eyes

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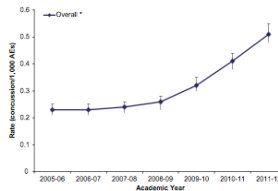
COVD Annual Meeting
Jacksonville, FL
27 April 2017

I HAVE NO FINANCIAL RELATIONSHIPS TO DISCLOSE OR CONFLICTS OF INTEREST TO RESOLVE.


HOW MANY KIDS GET CONCUSSIONS?

Langlois et al. 2006 - estimated 1.6-3.8 million sports and recreation-related TB annually



Rosenthal et al. HS RIO - 2005-2006 vs. 2011-2012 increases

Figure 1. High School Reporting Information Online (HS RIO) overall concussion rates with 95% confidence intervals from 2005-2006 through 2011-2012. AE, athlete-exposure. *P < .05.




NO, REALLY, HOW MANY?

Estimated 1.1-1.9 million SRR concussions 0-18 yo annually, including estimate of those not seeking medical care

Estimated 480K-540K concussions in 0-14 yo

Age (y)	Outp	ED	ED (95% CI)
0-5	24 071	—	4540 (3118-6960)
6-10	48 788 (47 856-49 801)	622 (467-783)	28 559 (27 184-29 942)
11-15	85 224 (81 775-88 683)	687 (565-855)	95 845 (94 892-96 811)
14-18	208 724 (206 483-210 980)	2722 (2472-2963)	79 525 (78 141-80 925)
Total	377 810 (374 808-381 120)	4096 (3646-4595)	116 950 (114 430-119 500)

CI, confidence interval.
* Medication includes data from outpatient.
* ED includes all hospital emergency department.
* Sample size too small to provide point estimate.



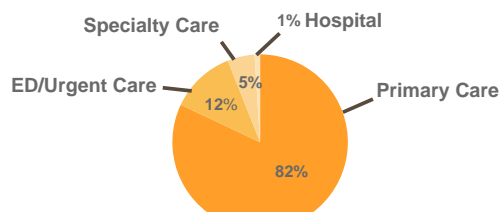
WHERE DO THESE KIDS SEEK CARE?

- O'Kane, 2014 - 55.9% middle school female soccer players with concussion symptoms never evaluated
- Mannix, 2013 - 800K outpatient visits, 1.2 million ED visits, 2005-2009
 - nearly 50% 0-18yo
- Coronado, 2015 - 3.42 million ED visits for sports concussion between 2001-2012
 - 70% 0-19 yo
- Taylor, 2015 - shift in location of care from ED/PCP to PCP/specialty care from 2007-2013




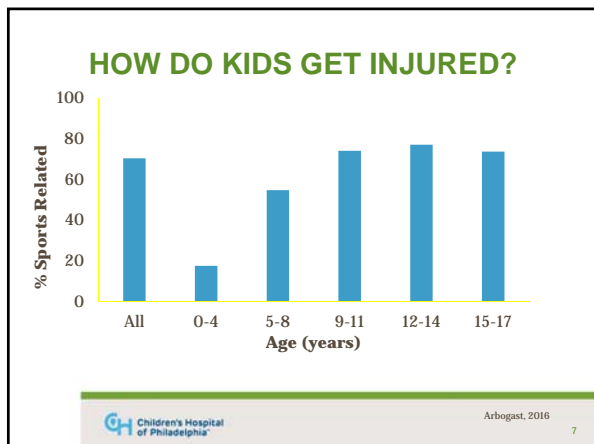
POINT OF ENTRY INTO CHOP NETWORK

Clinical setting of initial concussion visits, 2010-2014



Median [IQR] age at initial visit: 13 [10-15] years





- ### ARE WE PREPARED?
- ER/Primary Care – Zonfrillo, 2012; Arbogast, 2013
 - 92% PCPs refer concussions to specialist
 - 96-100% would like clinical decision support and concussion-specific discharge instructions
 - Only 28% of reviewed charts included return to school instructions
 - Primary Care – Kaye, 2010
 - 59% no CME in mTBI
 - Only 5.4% felt comfortable caring for children with prolonged symptoms
 - Specialty Care - Sports Medicine – Stache, 2016
 - 88% use return to play protocol
 - School Nurses – Wing, 2016
 - 38% report inadequate training in concussion

“Symptoms of concussion are produced by the transmission of the blow to the brain in the form of oscillations which disturb the relations of the molecules of the brain”

1896

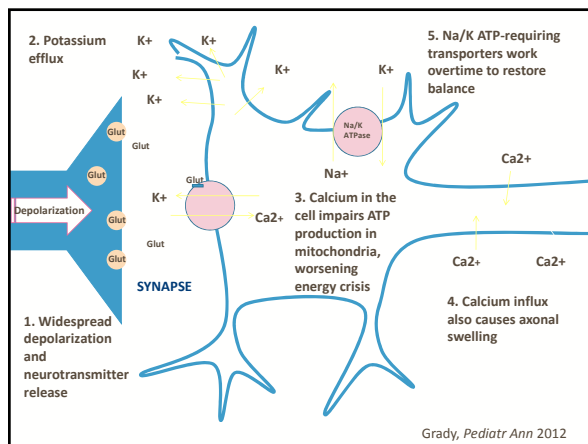
“Concussion is a brain injury defined as a complex pathophysiological process affecting the brain induced by biomechanical forces”

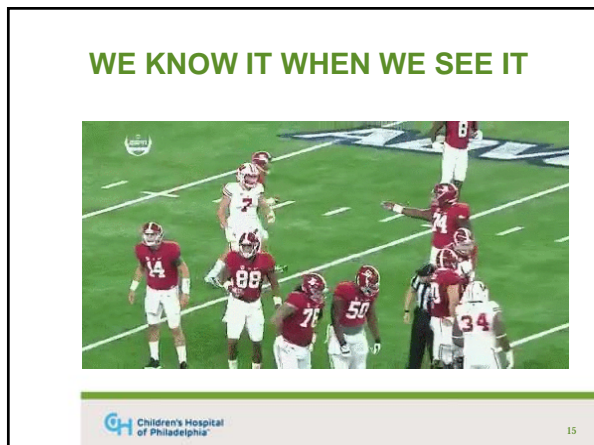
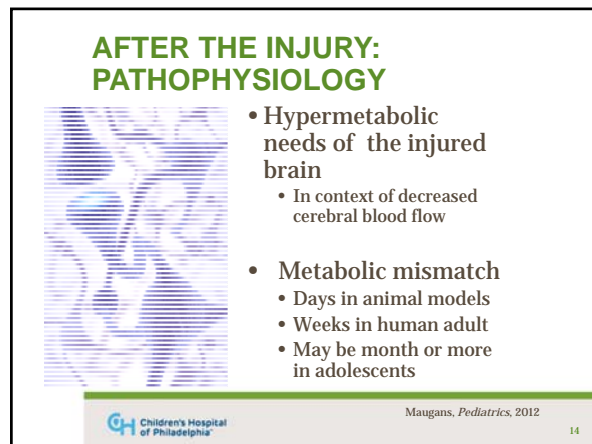
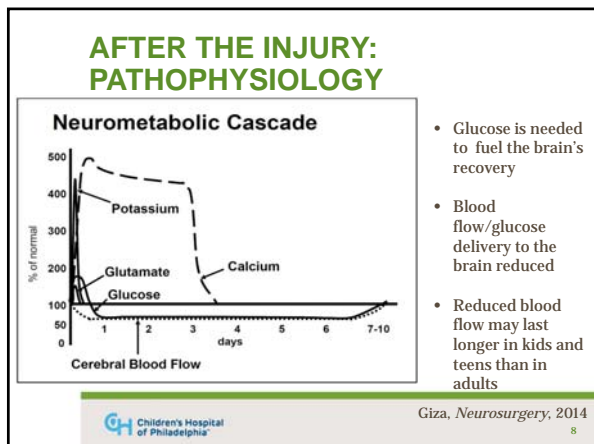
2012

WHAT IS A CONCUSSION?

- Concussion = traumatic brain injury
 - “My Child Doesn’t Have a Brain Injury, He Only Has a Concussion.”
- Traumatic brain injury induced by biomechanical forces

Dematteo, Peds, 2010, McCrory, BJSM 2017

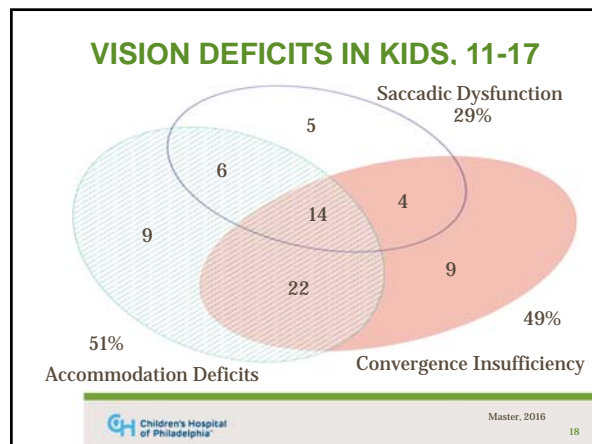
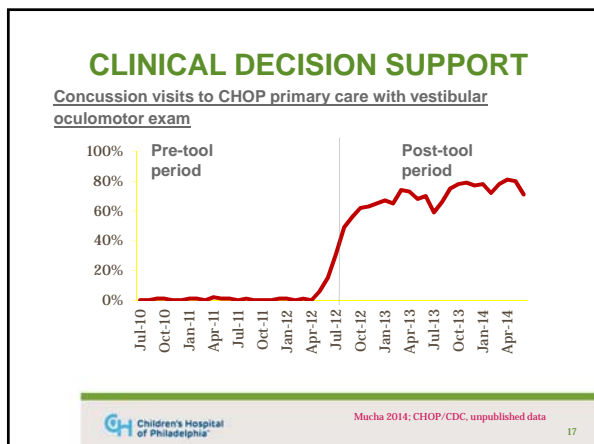


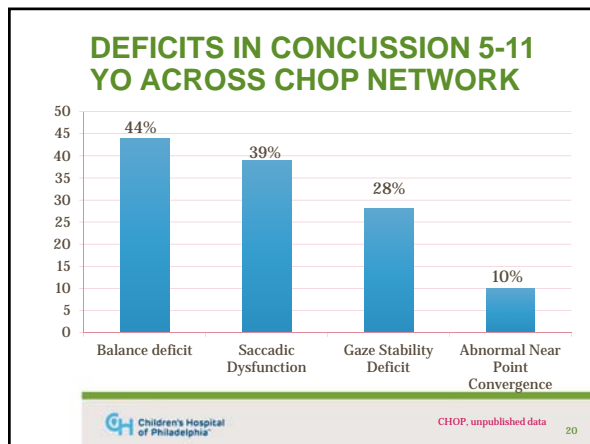
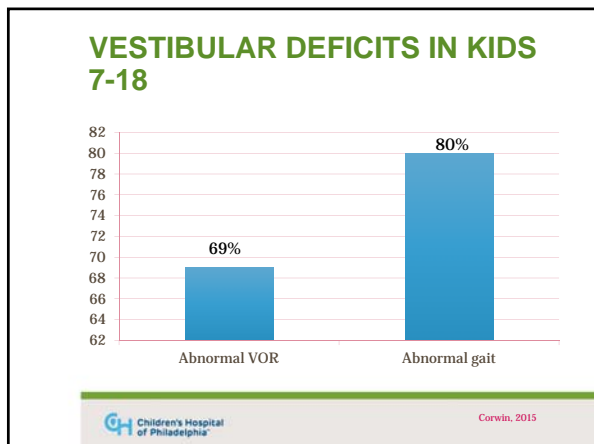


BUT DO WE?

I think I have a concussion, but your physical exam is normal

Children's Hospital of Philadelphia





TREATMENT OF ACUTE CONCUSSION

“The cornerstone of concussion management is physical and cognitive rest until the acute symptoms resolve and then a graded programme of exertion prior to medical clearance and RTP”

Vienna 2001-Zurich 2012

Children's Hospital of Philadelphia | McCrory P, et al. Br J Sports Med 2013

- ### CONTROVERSIES ABOUT REST IN CONCUSSION
- Preclinical evidence
 - Metabolic mismatch - inadequate fuel to brain immediately post injury¹
 - Early voluntary exercise post-injury in mice
 - No increase in BDNF, poorer cognitive function, may compromise plasticity²
 - Clinical evidence
 - Some rest in the first month helps reduce symptoms³
 - Prolonged rest beyond 2 days may increase symptoms⁴
 - One day of rest did not improve concussion recovery time⁵
 - Voluntary exercise after injury may be helpful^{6,7}
- Children's Hospital of Philadelphia | ¹Giza CC Neurosurgery 2014, ²Griesbach Neuroscience 2004, ³Moser RS J Pediatr 2012, ⁴Thomas DG Pediatrics 2015, ⁵Buckley TA J Head trauma Rehabil 2015, ⁶Leibly, ⁷Zemek JAMA 2016

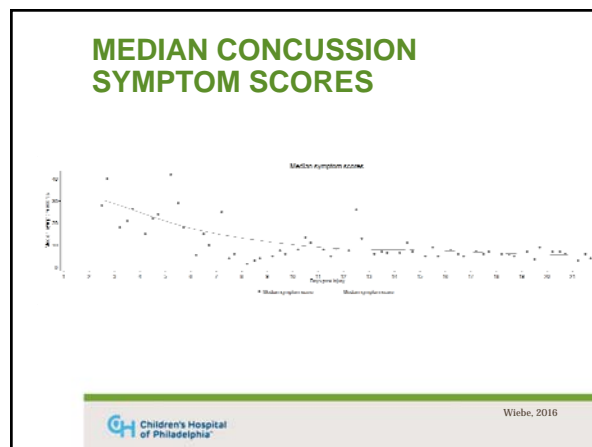
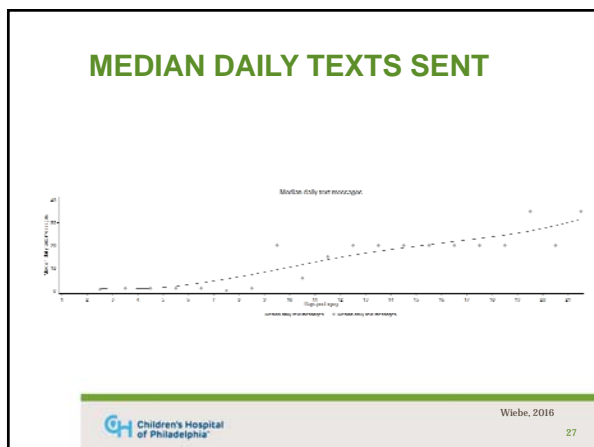
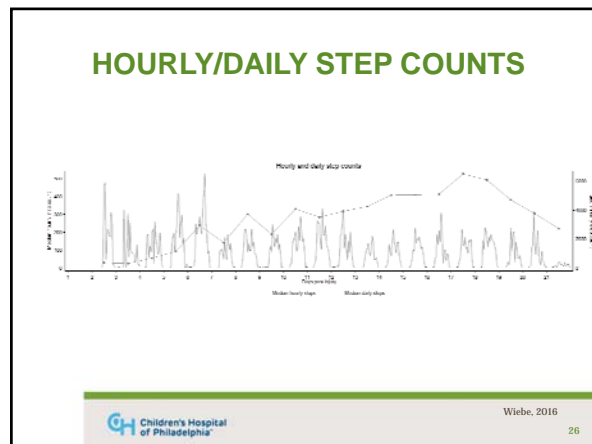
ECOLOGICAL MOMENTARY ASSESSMENT

“A collection of methods used in behavioral medicine research by which a research participant repeatedly reports on symptoms, affect, behavior, and cognitions close in time to experience and in the participant’s natural environment”

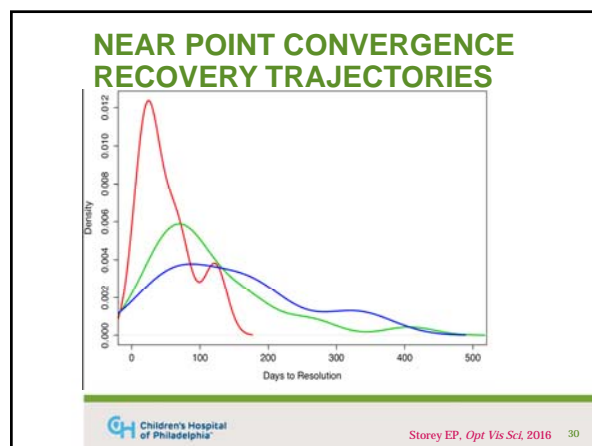
Children's Hospital of Philadelphia | Stone AA, et al. Annals of Behavioral Medicine. 1994

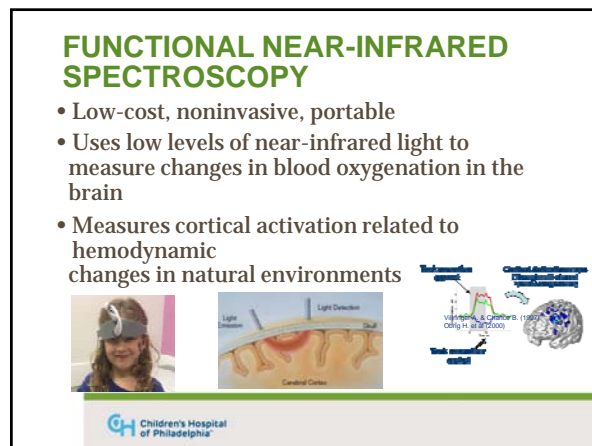
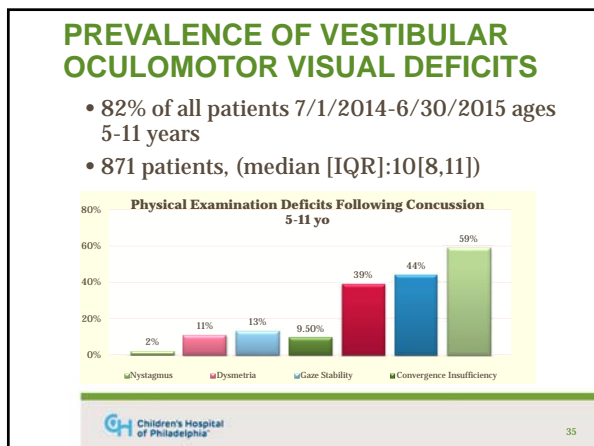
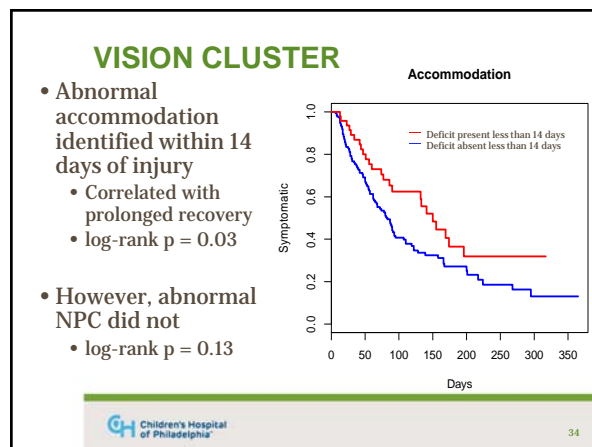
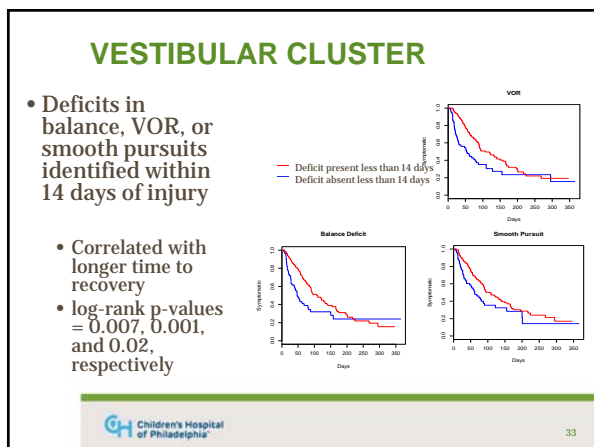
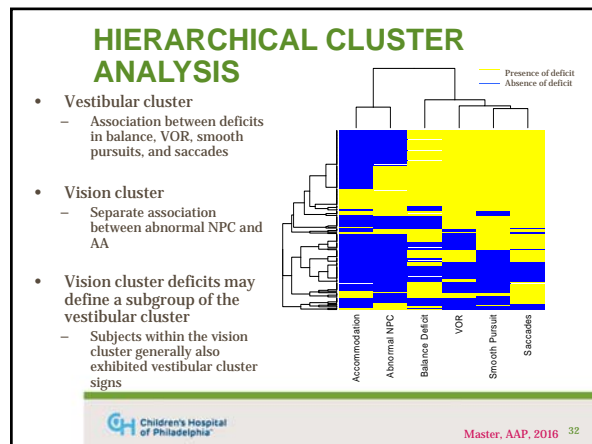
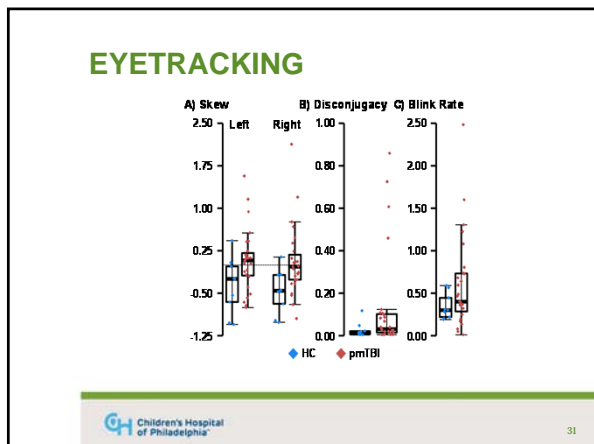
RECOUPS: ECOLOGICAL MOMENTARY ASSESSMENT

Children's Hospital of Philadelphia 25



- ### PERSISTENT SYMPTOMS
- With vestibular deficits:
 - Longer time to return to school (median 59 days vs. 6 days)
 - Longer time to return to sport (median 106 days vs. 29 days)
 - Scored more poorly on initial computerized neurocognitive testing
 - Took longer to recover neurocognitive deficits
 - 3 or more previous concussions with greater prevalence of vestibular deficits and took longer to recover
- Children's Hospital of Philadelphia Corwin DJ, et al. J Peds. 2015 29



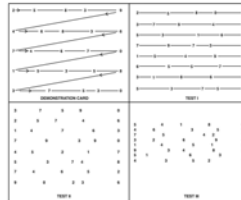


METHODS

- 38 cases < 2 months from concussion, 9 healthy controls
- Case subjects
 - Mean age: 14 ± 3.5 yo (6 subjects <10 yo)
 - 22 females, 16 males
 - 20 sports-related MOI (53%)
 - Seen a median of 16 days after injury (range, 1-53 days)
- Control subjects
 - Age-matched
 - Mostly female



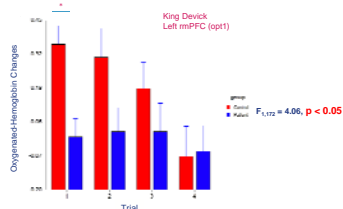
PRELIMINARY RESULTS: SENSITIVITY OF TASKS



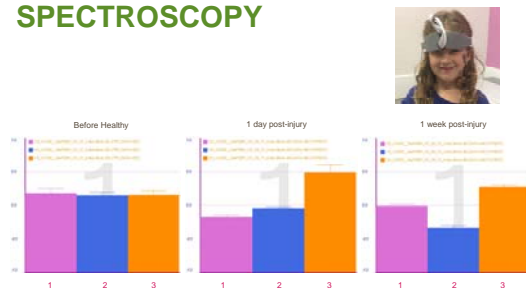
Oxygenation changes with varying conditions of King-Devick test. Cortical oxygenation changes differed significantly across increasingly difficult King-Devick test conditions ($F_{3,32}=4.65, p<0.01$).



PRELIMINARY RESULTS: K-D



FUNCTIONAL NEAR INFRARED SPECTROSCOPY



SIXTH ANNUAL MINDS MATTER: CONCUSSION CARE FOR KIDS, APRIL 13, 2018



• “Until you imagine something is possible, you’re going to miss it”

• F. Duncan M. Haldane, 2016 Nobel Laureate, Physics



3RD ANNUAL ZANDERFEST 2016

