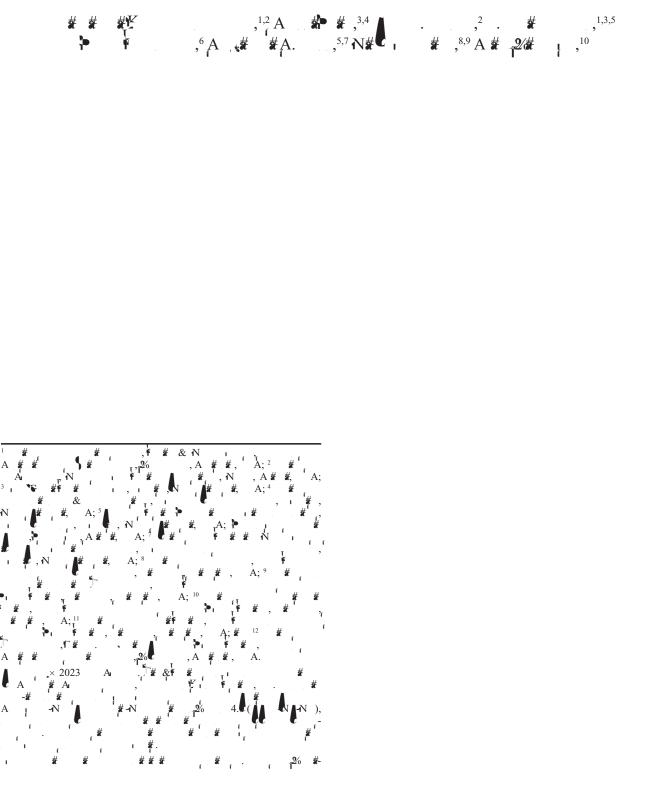
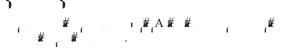
# Changing the Paradigm for School Hearing Screening Globally: Evaluation of Screening Protocols From Two Randomized Trials in Rural Alaska



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#.2011; #.2013; **#** 2012; & # . 2020). A #. 2015; **#**. (2020) 0.5, 1, 2, 4 6 4 Ħ #. 2016). # , # #. 2011). Ħ ; A 25 12 . 2022).



### MATERIALS AND METHODS

#### Study Design ¶ # j Ň ₩ í , **#**, А 2019#, ). #. # (2017 # # 2019) # 15 N Αź í 18 ), # .1 15( 0-1.158 ( 'n

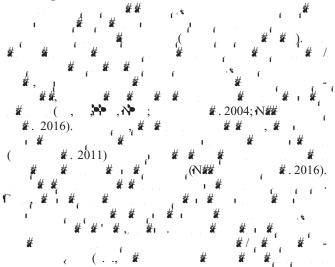
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تر mHealth Plus Tympanometry Screening Protocol

(1) #ı ), ı. +), (2⁄0 A # . 1997; 2000; Т 2012 í /. AN F / 85. ć # 95% 2000). /. TAN T #. 1997; :// / 85, Ħ 0.5, Ħ 2, Ħ # 30 2⁄6 0.5, 1, 2, 4, 6, 8 2014), 5 1 (0.5, 1, 2, (4, 6, 8 **1**: 20 4 (2) íí ł

#### **Missing Data**



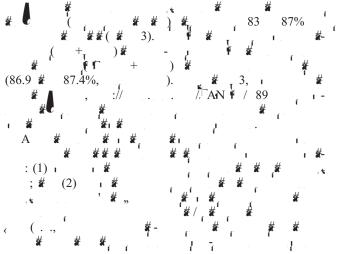


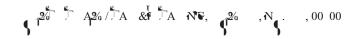
# RESULTS

# **Baseline Characteristics of the Analytic Sample**

#, 1449 2 Ħ (1034 #, 262 K '12 # ŧ í í ı. #, # 153 Ħ . 2), 1318 Ħ £ # # #.) ( 4 1 4 í đ 6, ΆŇ ı. 86. 2 # 10 71.2% 13. 777, 54%), = 1389, 96%), # # # N# Ħ 1 Ħ Ħ = 1,347, 95%). 4 147 (10%) # # ¥ >25 .26# 0.5, 2, А 246 (17%) # 4 9.2% 2.8% 4 1, ı. TAN I 89 2, (# <sup>2</sup>, <sup>1</sup> AN <sup>1</sup> / 89). ://

# **Diagnostic Accuracy**





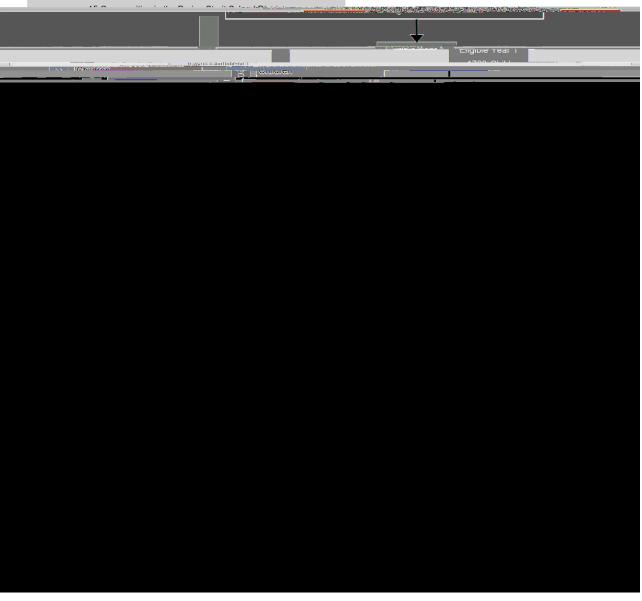
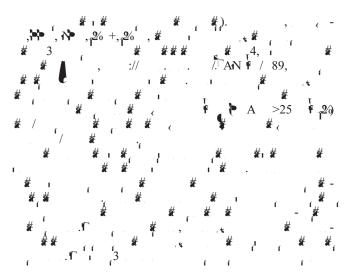
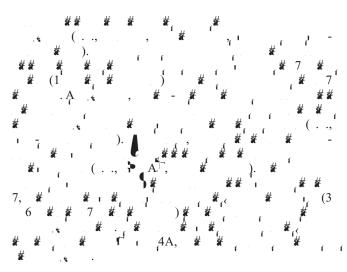


Fig. 2. STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) diagram for inclusion in study sample from main trial and ancillary trial. Final analytic study sample highlighted in red.





$$\int 2^{\frac{1}{2}} \int A^{\frac{1}{2}} A^{\frac{1}{2}}$$

 Tool 1: mHealth
 Pure-Tone
 Screening
 (1, 2, 4kHz)

 Alone
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 #
 #
 40.3%
 (36.2
 44.5)

 ( ) 1
 #
 # #
 #
 40.3%
 (36.2
 44.5)

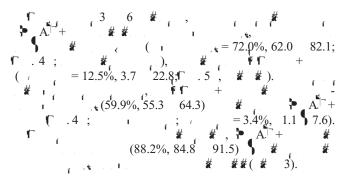
 #
 94.9%
 (93.9
 95.9),
 ( # 3).
 #

, = 59.8%, < .⊾\_ 55.6 63.9), **#** А¯Г I Ħ + = 58.6%, 54.5 62.8), ; ΎΓ :// 4, 1 /TAN 89). # 67.0% (62.7 71.3; A + # 5), i = 0.4%, 3.64.6;**ℾ** 5A). Ç.4); A. += 59.8%, 55.3 ↓ A<sup>¬</sup>+ 64.3;**F** Ħ ( ( 3.4%, 1.1 7.6; .5;  $A^{\Box}$ Tool 6: DPOAE With Tympanometry ) ( ).

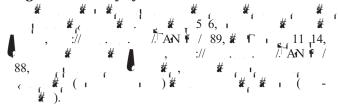
4.1 72.1) # 90.5% (89.3 91.8), #  $\Gamma$  + , A + # 68.1% (64.1 (# 3). , \*= 58.6%, 54.5 62.8) 4, 1 / AN / 89). # 1 # j 5), (# 4 1 10.2 3 6 4) 3)

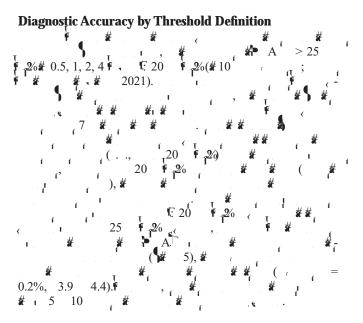
(# 3).



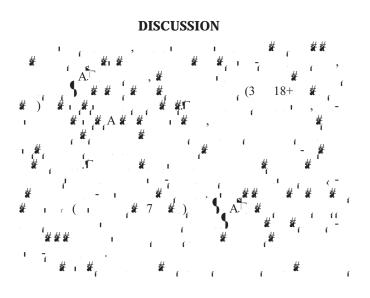


#### **Diagnostic Accuracy by Grade**









í - #

# /

6 18τ. ĩ ĩ2⁄0 #. (2004) 1003 í 449, 13 ĩ 12 17.1%. A **2**⁄0 # I, ,65% Ħ ₹ **2**6**#** 0.5, 1, 2, 4 >25 Ħ Ħ τ Ψ<sub>1</sub>2% A 1. 20 ¶\_j2∕₀ # í \* A >25 Þ ı . 2/35 ( **í** 10 125.1 1 8 5 (3 10 , 4 . г. 2) 85 (, 65% #. г. 95 ()25 ( # í

22.4

16.8%

28.6%),

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TABLE 3. Diagnostic accuracy (with 95% confidence intervals) of index screening protocols by reference standard using complete case data for all ages	vith 95% cc	onfidence i	intervals) of ir	ndex screening	protocols by refer	rence standard using	complete case da	ta for all ages		
Z	Sensitivity	itivity	Speci city	ЛЧЧ	NPV	LR+	LR-	Youden Index	Concordance	
Full audiometric evaluation with high frequency (>25 dB)* MS 2541 40.3 (36.2, 44.5)	gh frequency 40.3 (36.	y (>25 dB)* .2, 44.5) 9	94.9 (93.9, 95.9)	9) 68.0 (62.9, 73.1)	73.1) 85.6 (84.1, 87.0)	7.0) 7.92 (6.22, 9.63)	) 0.63 (0.58, 0.67)	) 35.2 (31.0, 39.5)	83.4 (81.9, 84.8)	
2541	49.1 (44.8, 53.3)		93.7 (92.6, 94.8)					_	84.3 (82.8, 85.7)	
2560	57.7 (53.		91.3 (90.1, 92.6)					_	84.2 (82.8, 85.6)	
MS + Tymp 2525	60.2 (56.0, 64.4)		94.0 (92.9, 95.0)		76.8) 89.9 (88.6, 9	<u>_</u>		_	86.9 (85.6, 88.2)	
dm	67.0 (63.		92.8 (91.6, 93.9)	9) 71.1 (67.2, 75.1)	75.1) 91.4 (90.1, 92.6)			) 59.8 (55.6, 63.9)	87.4 (86.1, 88.7)	
et	68.1 (64.1, 72.1)		90.5 (89.3, 91.8)		59.6) 91.5 (90.2, 92.7)				85.8 (84.5, 87.2)	
2733	45.7 (40.		91.6 (90.5, 92.7)	7) 43.5 (38.4, 48.7)	18.7) 92.3 (91.2, 93.3)	3.3) 5.45 (4.49, 6.40)	) 0.59 (0.53, 0.65)	) 37.3 (31.9, 42.7)	85.9 (84.6, 87.2)	
2733	50.1 (44.8, 55.5)		88.9 (87.7, 90.2)						84.1 (82.7, 85.5)	
DPOAE 2840	67.6 (62.		87.5 (86.2, 88.	8) 44.6 (40.5, 48.7)					85.0 (83.7, 86.3)	
MS + Tymp 2711	82.6 (78.5, 86.7)		90.4 (89.3, 91.6)				_	) 73.0 (68.7, 77.3)	89.5 (88.3, 90.6)	ſ
HF MS + Tymp 2711	84.4 (80.		87.9 (86.6, 89.2)		53.0) 97.6 (97.0, 98.3)		_		87.5 (86.2, 88.7)	2 <sup>2</sup> /
DPOAE + Tymp 2817	88.2 (84.8, 91.5)		86.6 (85.3, 87.9)	9) 48.7 (44.8, 52.5)	52.5) 98.1 (97.5, 98.6)	8.6) 6.58 (5.87, 7.28)	0.14 (0.10, 0.18)	) 74.8 (71.1, 78.4)	86.8 (85.5, 88.0)	
and includes referred for and	1 on our out			10 7 7 7 7 7 7 0 F		ooto lotinik OD wtomonoomu	and the second	i nominalina postinativ	office adfinition addition	
rkererence standard includes retertar for: pure-tone average (U.S., 1, 2, 4 kHz) >25 dB UK any tone (U.S., 1, 2, 4, 6, 5 KF ottits media, otorrhea, perforation, patent or plugged tube, external ottits, foreign body) requiring healthcare follow-up	-tone average (u ugged tube, exte	ernal otitis, fore	) >25 dB UK any to eign body) requirin	ne (U.5, 1, ∠, 4, 6, 8KHZ) g healthcare follow-up.	<u>.</u>	30 db UK type b/L tympanometry UK digital otoscopy with pathological initiangs (occurang cerumen, retraction, enusion, acute	copy with pathological find	aings (occiuaing cerumen, r	etraction, errusion, acute	A2
Reference standard includes type B or C tympanometry OR otoscopy findings of retraction, effusion, acute otitis media, otorrhea, perforation, presence of tympanostomy tube, or external otitis requiring healthcare follow-up. PDOAE, instruction product otoacoustic emissions: HF, high frequency (add 6 kHz); LR+, positive likelihood ratio; LR-, negative likelihood ratio; MS, mHealth Screen (1, 2, 4 kHz); NPV, negative predictive value: PPV, positive pr	panometry OR c ons; HF, high fre	otoscopy findin equency (add 6	igs of retraction, ef kHz); LR+, positive	fusion, acute otitis me e likelihood ratio; LR-,	edia, otorrhea, perforation , negative likelihood ratio;	titis media, otorrhea, perforation, presence of tympanostomy tube, or external otitis requiring heatthcare follow-up. o: LR-, negative likelihood ratio: MS, mHealth Screen (1, 2, 4kHz). NPV, negative predictive value: PPV, positive predictive value: Tymp, tym-	ube, or external otitis requ <hz); negative="" npv,="" predici<="" th=""><th>liring healthcare follow-up. tive value; PPV, positive pre</th><th>dictive value; Tymp, tym-</th><th>á / Ĩ A</th></hz);>	liring healthcare follow-up. tive value; PPV, positive pre	dictive value; Tymp, tym-	á / Ĩ A
										A &
TABLE 4. Diagnostic accuracy statistics (with 95% confidence intervals) for children aged 3 to 6* by index tool and missing data approach, by reference standard	atistics (wit	th 95% cor	nfidence inter	vals) for childre	en aged 3 to 6* by	index tool and missir	ng data approach,	by reference stands	Ird	,⊤A
Reference Standard and Index Tool	z	Sensitivity	tivity	Speci city	ΔD	NPV	LR+	LR-	Youden Index	N
High-frequency gold standard (>25dB)1	dB)†									Б,
Complete case Ref MI, missing index as pass	2541 2898	22.4 (12.4, 32.4) 16.8 (11.3, 22.3)		.9 (92.6, 97.2) .6 (92.6, 96.6(11	94.9 (92.6, 97.2) 45.5 (28.5, 62.4) 94.6 (92.6, 96.6(11.3, 22.3)	86.5 (83.1, 89.9) 8 <b>đi© (18</b> 30) 6 <b>2</b> 8 A)1 di	4.4 (1.60, 7.13) z),c44 (4.047.60, 27.53)	86.5 (83.1, 89.9) 4.4 (1.60, 7.13) 0.82 (0.71, 0.93) 17.3 (7.0, 27.5)	17.3 (7.0, 27.5) t <fef7.32(m0ss27).5)in< td=""><td>EMC 20Td</td></fef7.32(m0ss27).5)in<>	EMC 20Td

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,<sup>N</sup>∫.

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	2733 26.1 (17.		2898		
Middle ear disease‡ MS	Complete case	Ref MI, missing index as pass	Ref MI, missing index MI	HFMS	

ĩ	26	_	Ľ,	Ą	2⁄0	/ <sup>•</sup> A	L	&	730260950245 (0.:
	18.7 (9.4, 27.9)	13.4 (6.2, 20.6)	20.6 (12.1, 29.1)	16.5 (7.2, 25.9)	11.7 (4.4, 19.0)	19.5 (10.7, 28.3)	48.4 (39.2, 57.6)	49.3 (40.2, 58.3)	50.2 (41.2, 5.6e8.9 <sup>-</sup>
	0.80 (0.70, 0.90)	0.86 (0.78, 0.93)	0.77 (0.68, 0.87)	0.82 (0.72, 0.92)	0.87 (0.80, 0.95)	0.78 (0.68, 0.88)	0.47 (0.37, 0.57)	0.46 (0.37, 0.56)	0.45 (0.35, 0.55)
	3.5 (1.86, 5.16)	3.2 (1.67, 4.79)	3.3 (1.96, 4.63)	2.7 (1.52, 3.94)	2.5 (1.36, 3.64)	2.7 (1.70, 3.70)	6.5 (4.51, 8.59)	6.9 (4.67, 9.07)	6.8 (4.71, 8.98)
	86.5 (83.5, 89.5)	83.9 (81.0, 86.7)	85.1 (82.3, 88.0)	86.2 (83.2, 89.3)	83.6 (80.7, 86.5)	85.0 (82.1, 87.9)	90.8 (88.4, 93.2)	90.6 (88.2, 93.0)	90.8 (88.4, 93.2)
	40.7 (28.1, 53.2)	42.0 (29.4, 54.7)	42.6 (31.5, 53.7)	34.8 (23.5, 46.0)	35.9 (24.6, 47.3)	37.8 (27.9, 47.8)	58.6 (49.7, 67.6)	60.7 (51.6, 69.7)	60.7 (51.9, 69.5)
			91.0 (88.2, 93.7)		92.2 (90.0, 94		91.3 (88.9, 93.	91.6 (89.3, 93.	
	26.1 (17.1, 35.1)	19.5 (12.6, 26.4)	29.7 (21.5, 37.8)	26.1 (17.1, 35.1)	19.5 (12.6, 26.4)	31.1 (22.7, 39.4)	57.1 (48.3, 66.0)	57.7 (49.0, 66.3)	58.8 (50.2, 67.5)
	2733	2898	2898	2733	2898	2898	2840	2898	2898
CIVI	Complete case	Ref MI, missing index as pass	Ref MI, missing index MI HF MS	Complete case	Ref MII, missing index as pass	Ref MI, missing index MI DPOAE	Complete case	Ref MII, missing index as pass	Ref MI, missing index MI

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