

TELEPRACTICE IN PEDIATRIC AUDIOLOGY: EXPANDING AUDIOLOGY HORIZONS FOR CHILDREN WITH HEARING LOSS



De Wet Swanepoel, PhD

1. Dept of Speech-Language Pathology & Audiology, University of Pretoria, South Africa
2. Ear Sciences Centre, University of Western Australia, Ear Science Institute Australia
3. Callier Center for Communication Disorders, University of Texas at Dallas, USA

ACKNOWLEDGEMENTS

Leigh Biagio & Faheema Mahomed, *Dept of Speech-Language Pathology & Audiology, University of Pretoria, **South Africa***

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Prof Robert Eikelboom, *Ear Sciences Centre, School of Surgery, University of Western Australia & Ear Science Institute **Australia***

OUTLINE

- **Global Childhood Hearing Health – Challenges**
 - *Prevalence*
 - *Access to care*
- **Exploring Novel Solutions - Telehealth**
 - *Remote diagnosis of hearing loss in primary health care*
 - *Remote diagnosis of ear disease in primary health care*



PREVALENCE OF CHILDHOOD HL

Global Situation

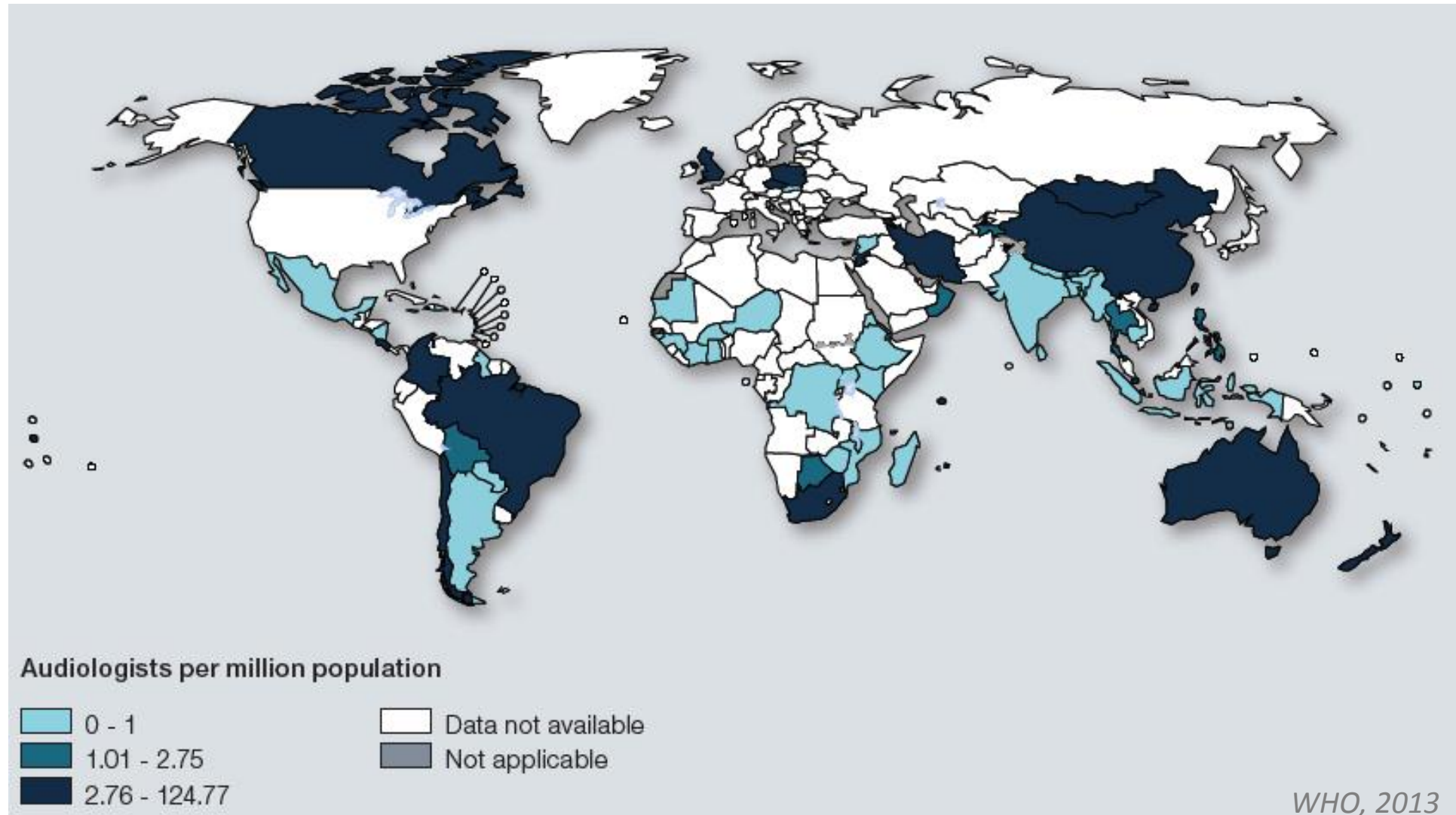
- Everyday **1 753** born with significant permanent SNHL:
 - **1 643** born in developing world (5/1000)
 - **110** born in developed countries (3/1000)
- **>90%** born in developing world



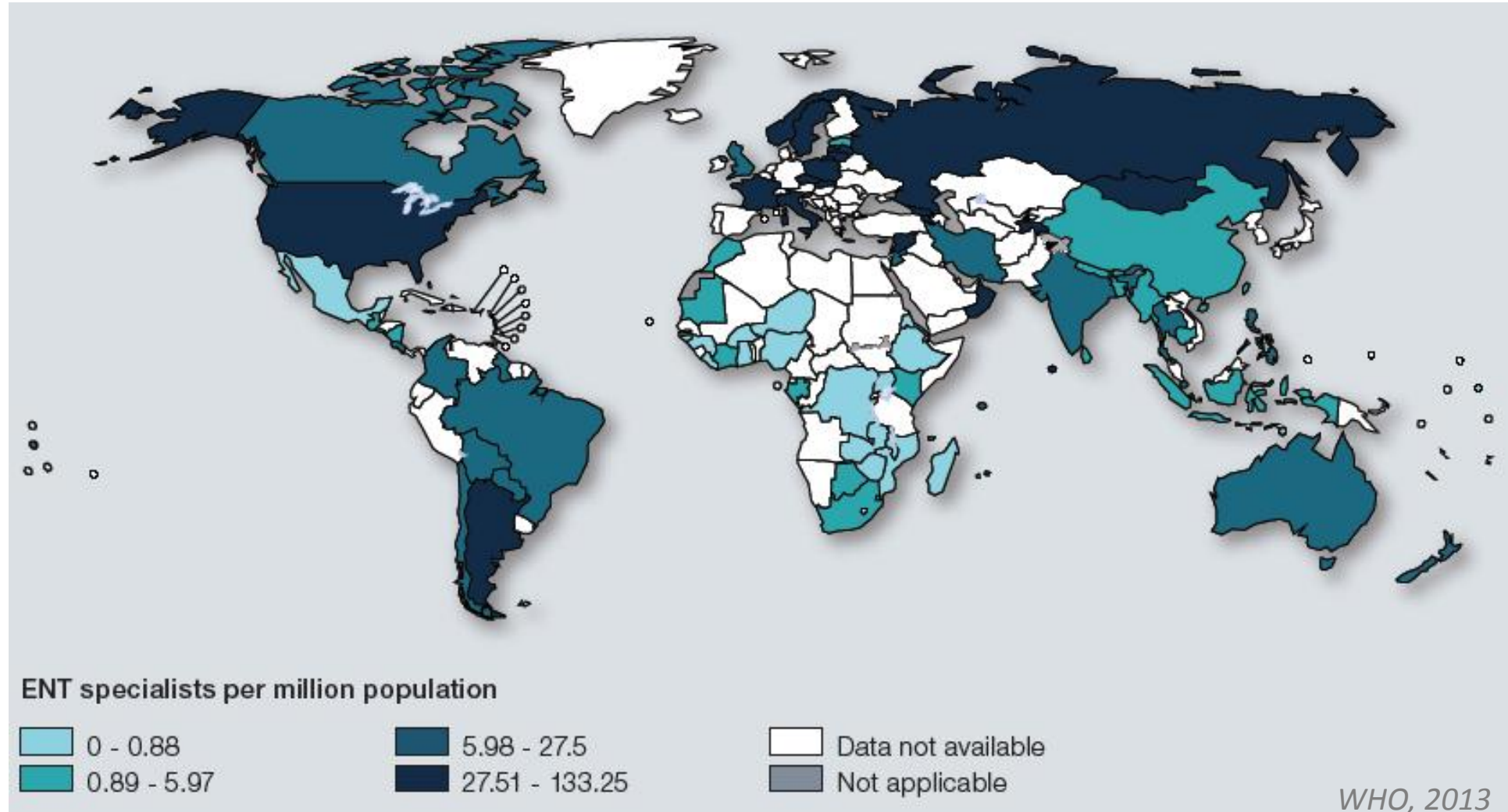
PREVALENCE OF CHILDHOOD HL

Regions	DHL in children (<15 yoa)	
	Millions	Prevalence %
High-income	0.8	0.5
Sub-Saharan Africa	6.8	1.9
Middle East & North Africa	1.2	0.9
South Asia	12.3	2.4
Asia Pacific	3.4	2.0
Latin America & Carriibbean	2.6	1.6
East Asia	3.6	1.3
World	31.9	1.7

HEARING HEALTH CARE ACCESS



HEARING HEALTH CARE ACCESS





HEARING HEALTH CARE **ACCESS**

- Available hearing health service distribution inequality
- Geographical, weather and infrastructure obstacles
 - *Large distances & remote communities*
 - *Poor transport infrastructure*
 - *Expensive referral pathways*

EXPLORING TELEHEALTH

- Telehealth literally means “**health care at a distance**”.
- Refers to “**utilization of information and communication technology in health care**”.
- Provision of health services from one location to another using a **telecommunications medium**. Includes concepts of surveillance, health promotion and public health functions
- Terminology: **telemedicine**, online health, **e-Health**, telepractice. “**Tele**” i.e. Tele-audiology, tele-therapy, tele-intervention.
- Recent addition – **mHealth** – provision of health care and public health, supported by mobile devices

TELEHEALTH - ICT



RADIO NEWS

25 Cents

April

1924

Over 200 Illustrations

Edited by H. GERNSBACK

THE RADIO DOCTOR—*Maybe!*

See Page 1486



IN THIS ISSUE:

Sir Oliver Lodge, F.R.S.
Dr. J. A. Fleming, F.R.S.
F. W. Dunmore and
F. H. Engel of
Bureau of Standards
Howard S. Pyle
Brainard Foote

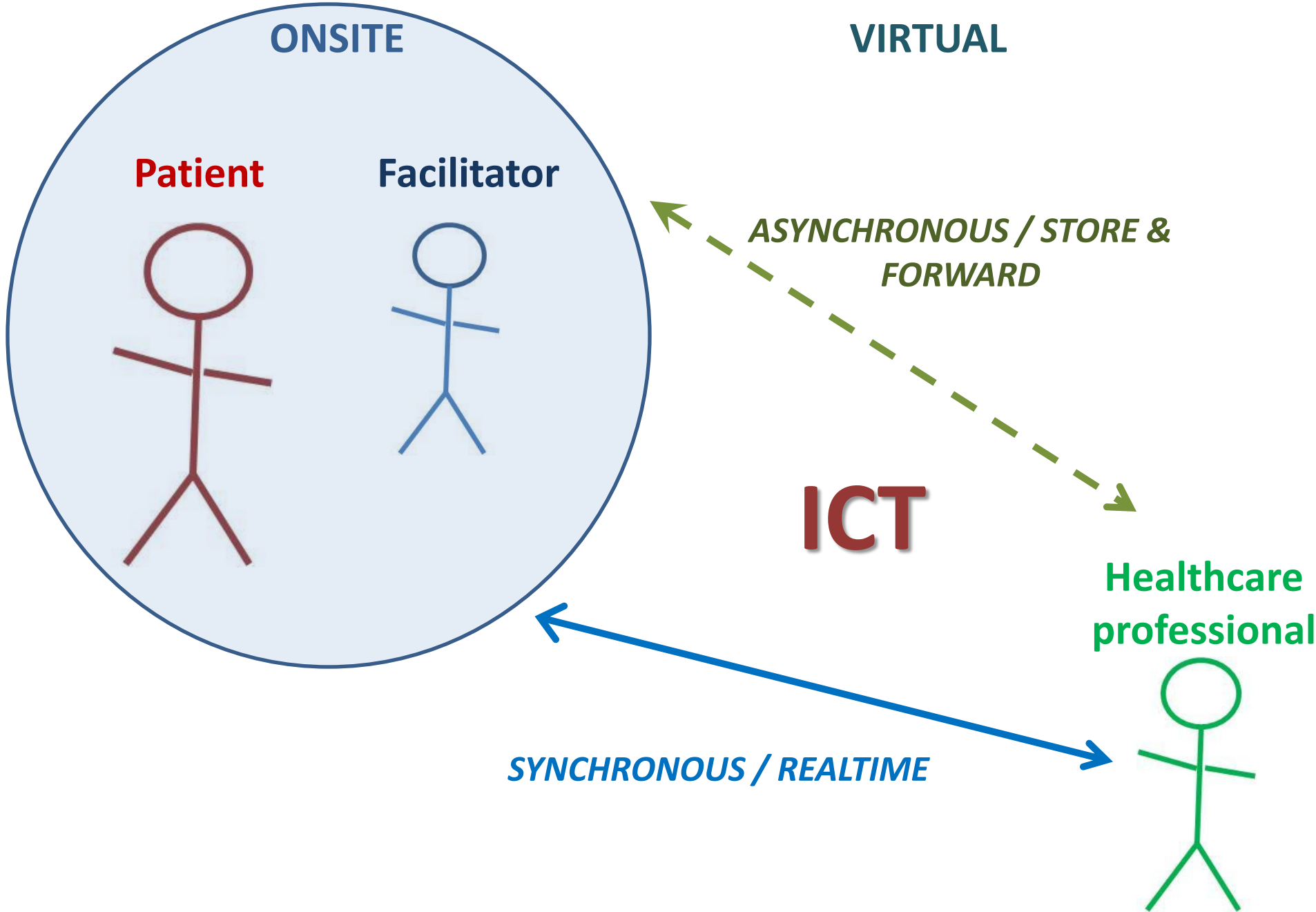
THE 100% RADIO MAGAZINE

Concept as old as
telecommunication
mediums

TELEMEDICINE MODELS

- **Synchronous, real-time**
 - *Videoconferencing*
 - *Desktop sharing software*
 - *Remote hardware control*
- **Asynchronous, store-and-forward**
 - *Fax, Email, Server uploads*
 - *Automation NB component*
- **Hybrid model**



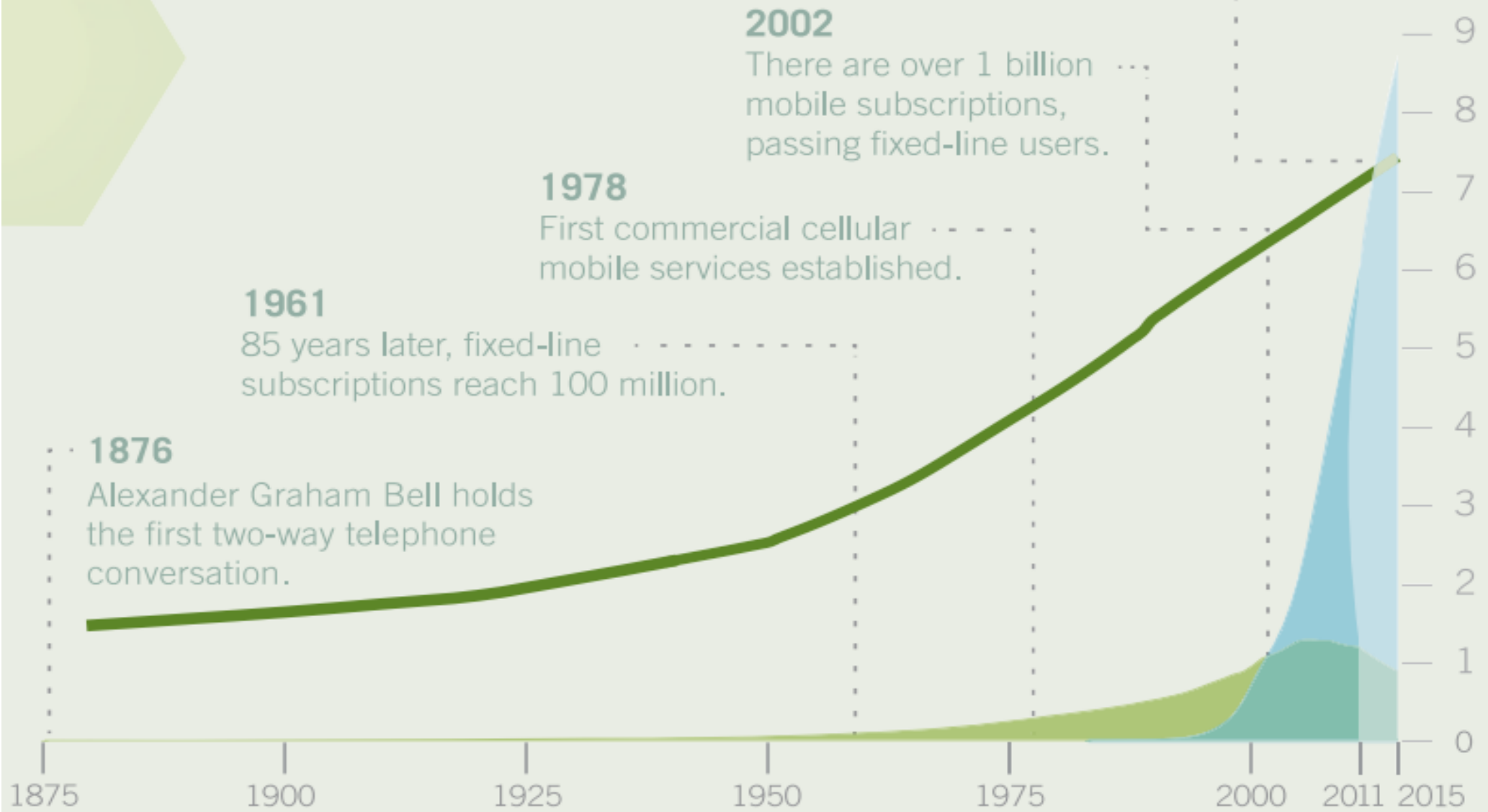


MOBILE REVOLUTION

CONNECTIVITY

The number of mobile subscriptions will soon overtake the world's population

BILLIONS



2002

There are over 1 billion mobile subscriptions, passing fixed-line users.

1978

First commercial cellular mobile services established.

1961

85 years later, fixed-line subscriptions reach 100 million.

1876

Alexander Graham Bell holds the first two-way telephone conversation.

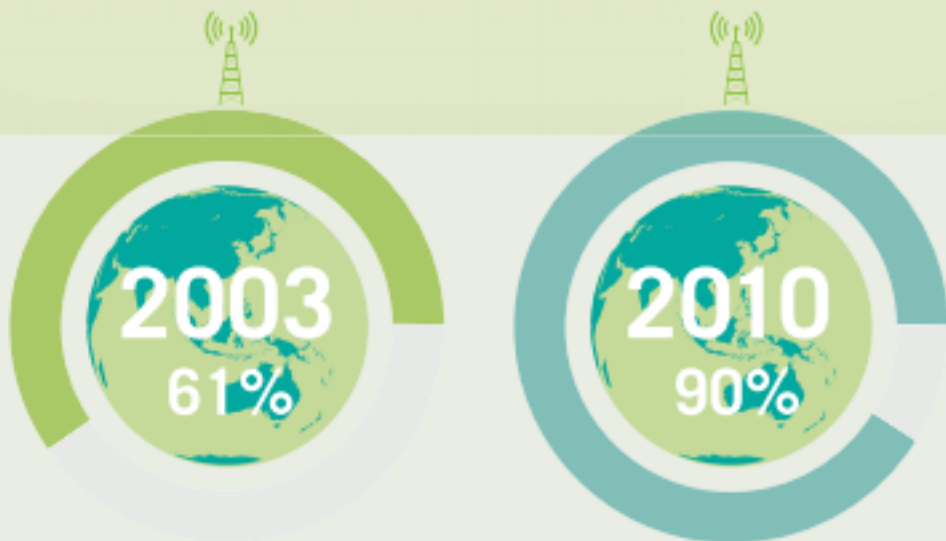
GLOBAL POPULATION

FIXED-LINE SUBSCRIPTIONS

MOBILE SUBSCRIPTIONS ¹

World Bank, 2012

THE PACE AT WHICH
MOBILE PHONES
SPREAD GLOBALLY IS
UNMATCHED
IN THE
HISTORY OF TECHNOLOGY



PERCENT OF THE WORLD'S POPULATION WITH MOBILE CELL SIGNAL²



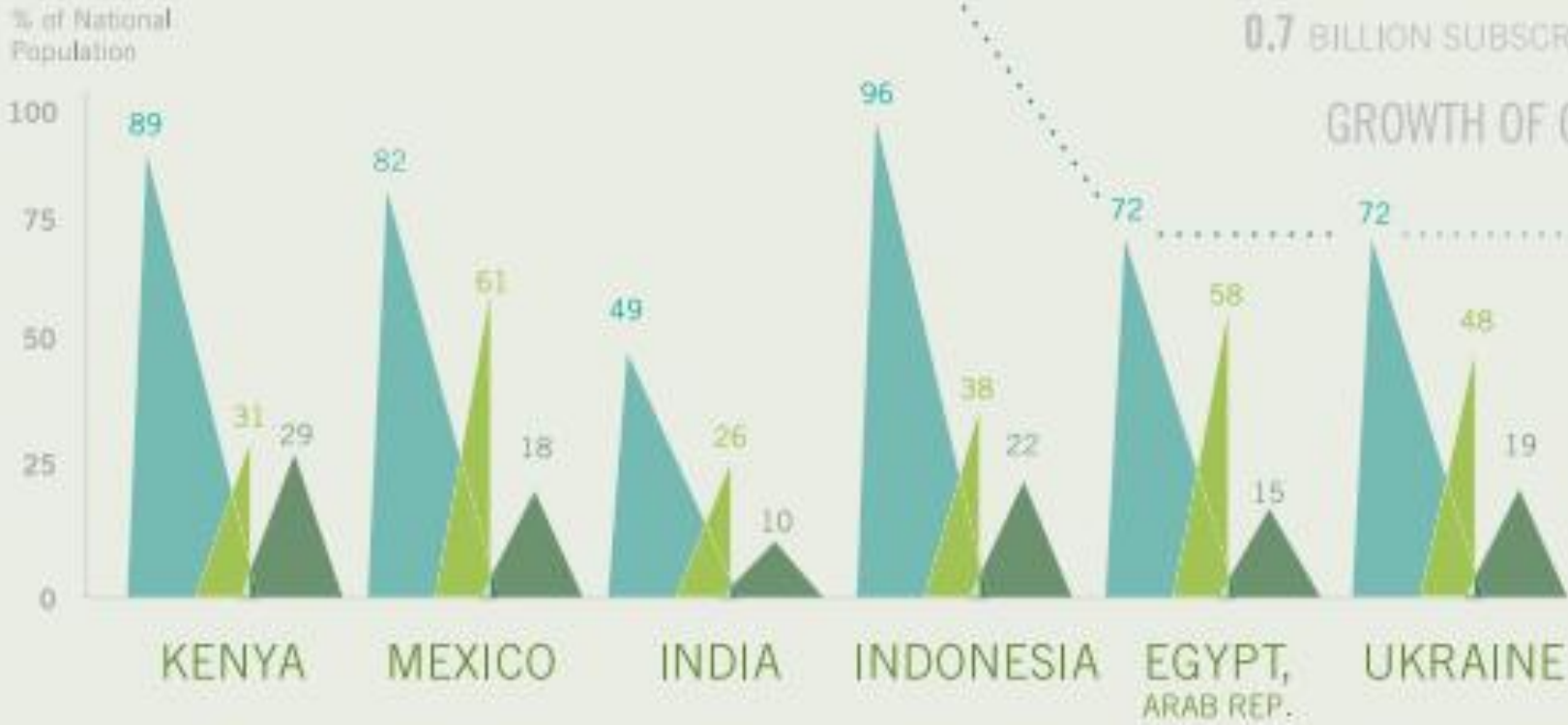
THE DEVELOPING WORLD IS NOW **MORE MOBILE** THAN THE DEVELOPED WORLD

MOST PHONES ARE OWNED BY PEOPLE **LIVING IN LOW-INCOME REGIONS**



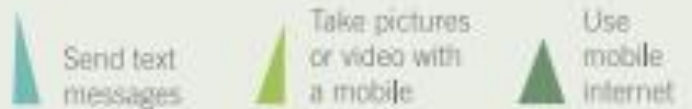
GROWTH OF GLOBAL MOBILE SUBSCRIPTIONS⁴

ACCESS TO A RANGE OF MOBILE APPLICATIONS HAS **INCREASED DRAMATICALLY** THROUGHOUT THE LAST DECADE

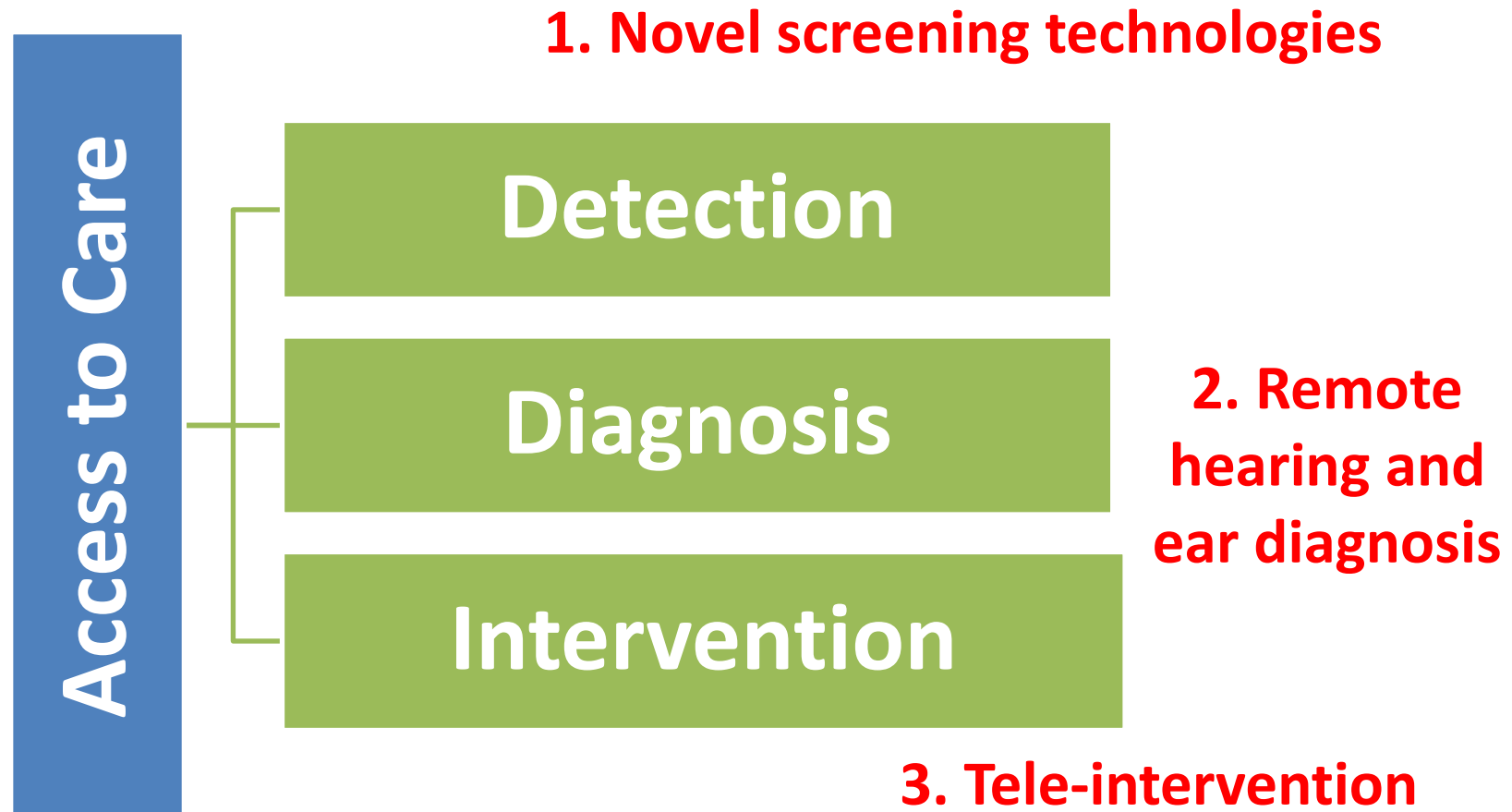


RISE OF NON-VOICE MOBILE USAGE in 2011¹

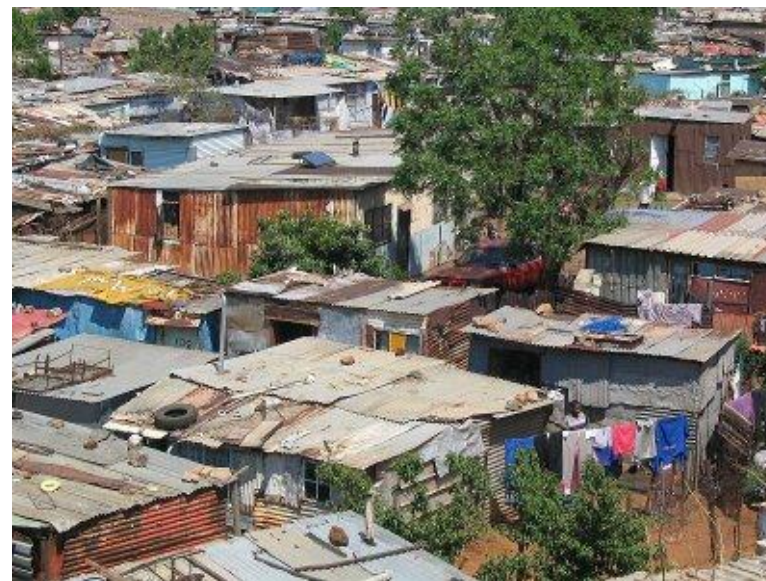
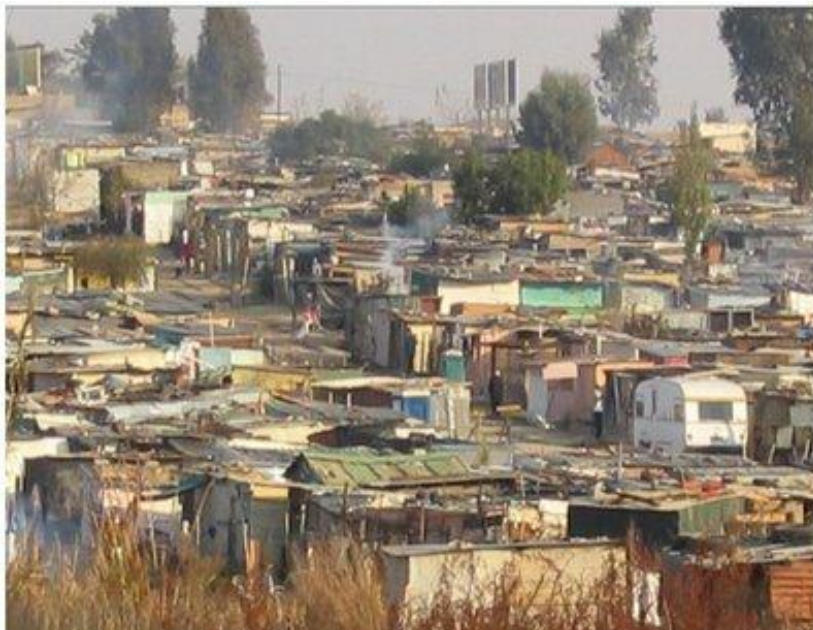
World Bank, 2012



EXPLORING NOVEL SOLUTIONS



WITKOPPEN CLINIC - DIEPSLOOT



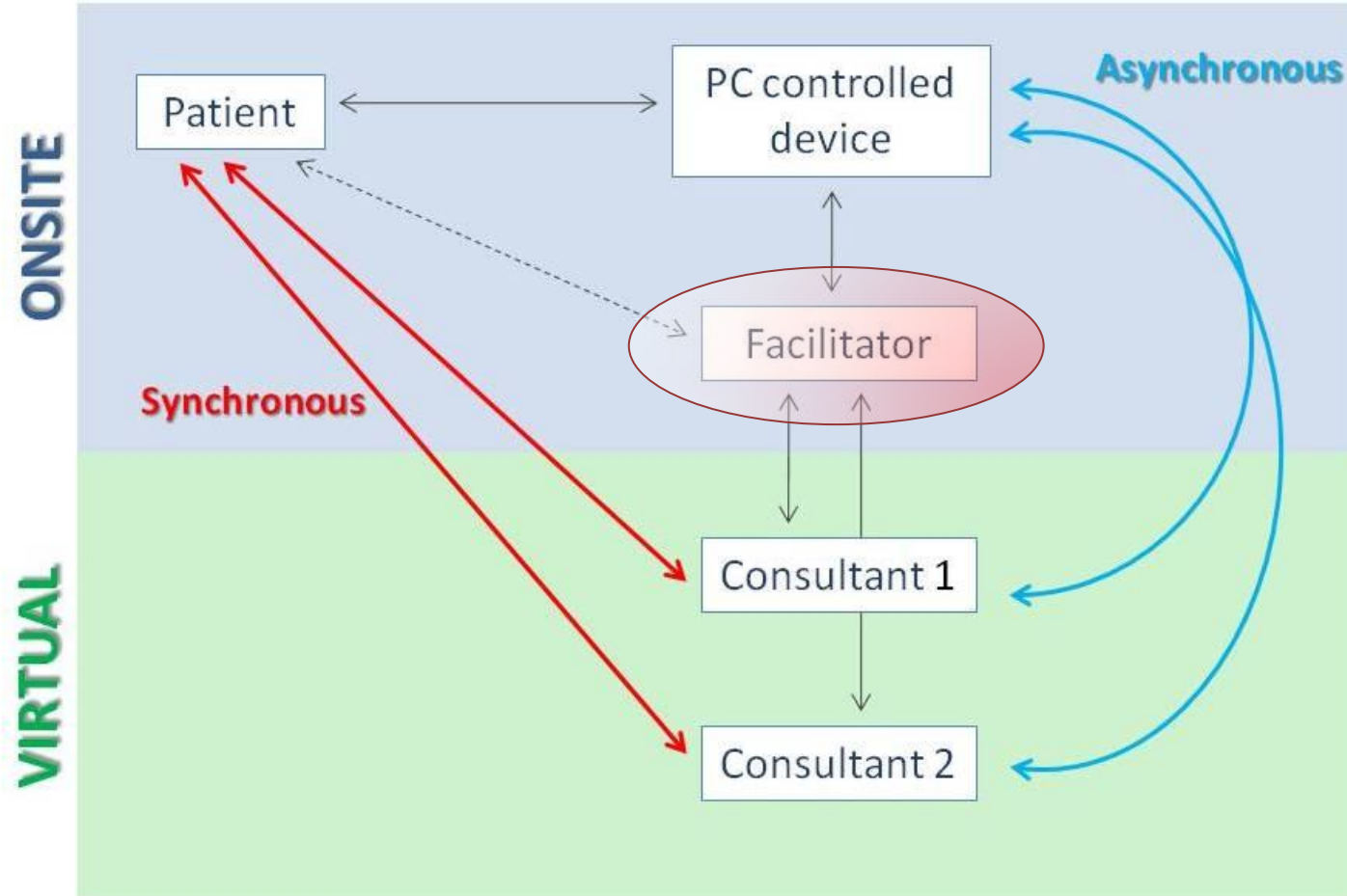
WITKOPPEN CLINIC - DIEPSLOOT





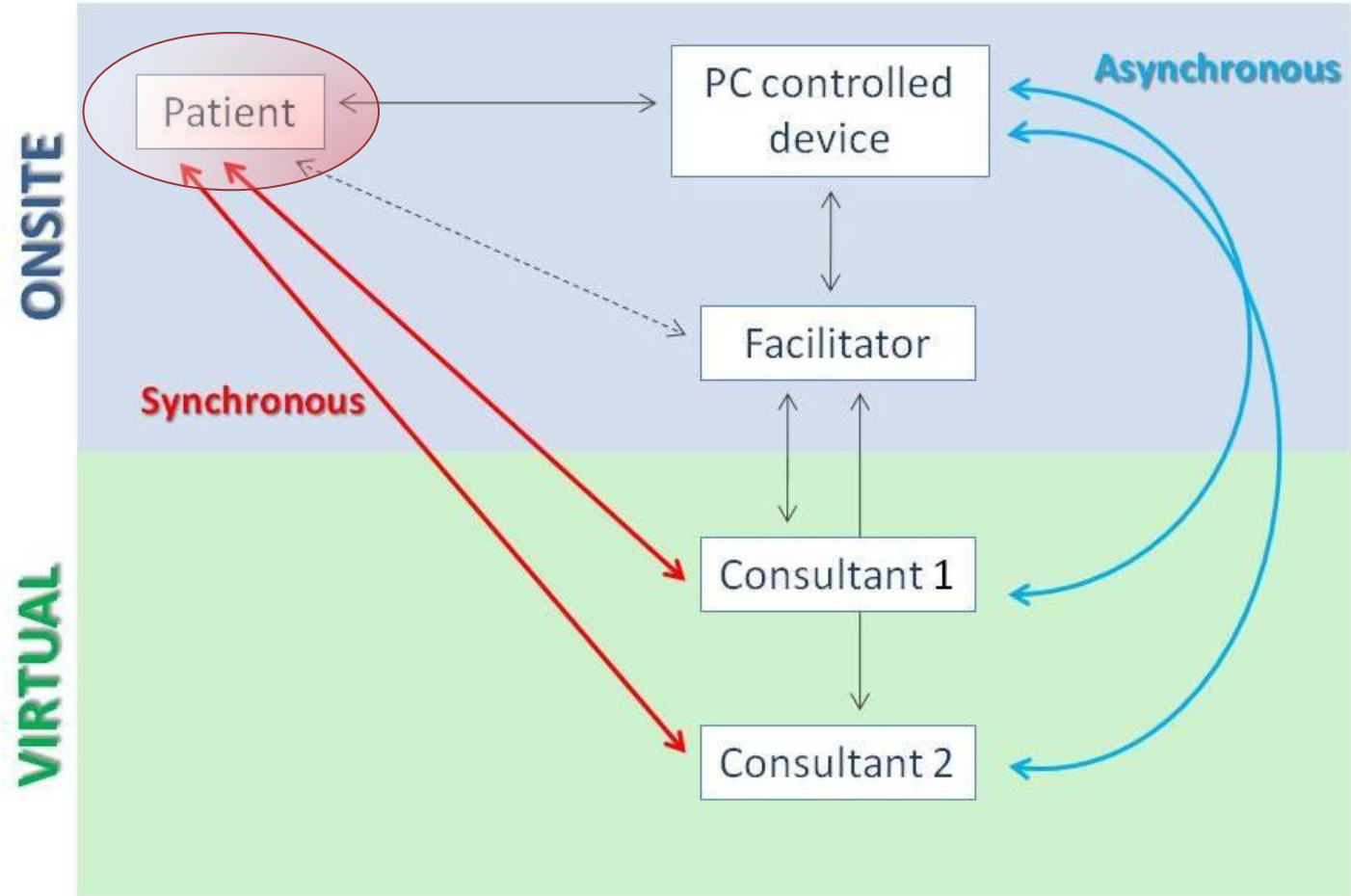
Witkoppen clinic
University of Pretoria
eMoyoDotNet

TELE-AUDIOLOGY CLINIC



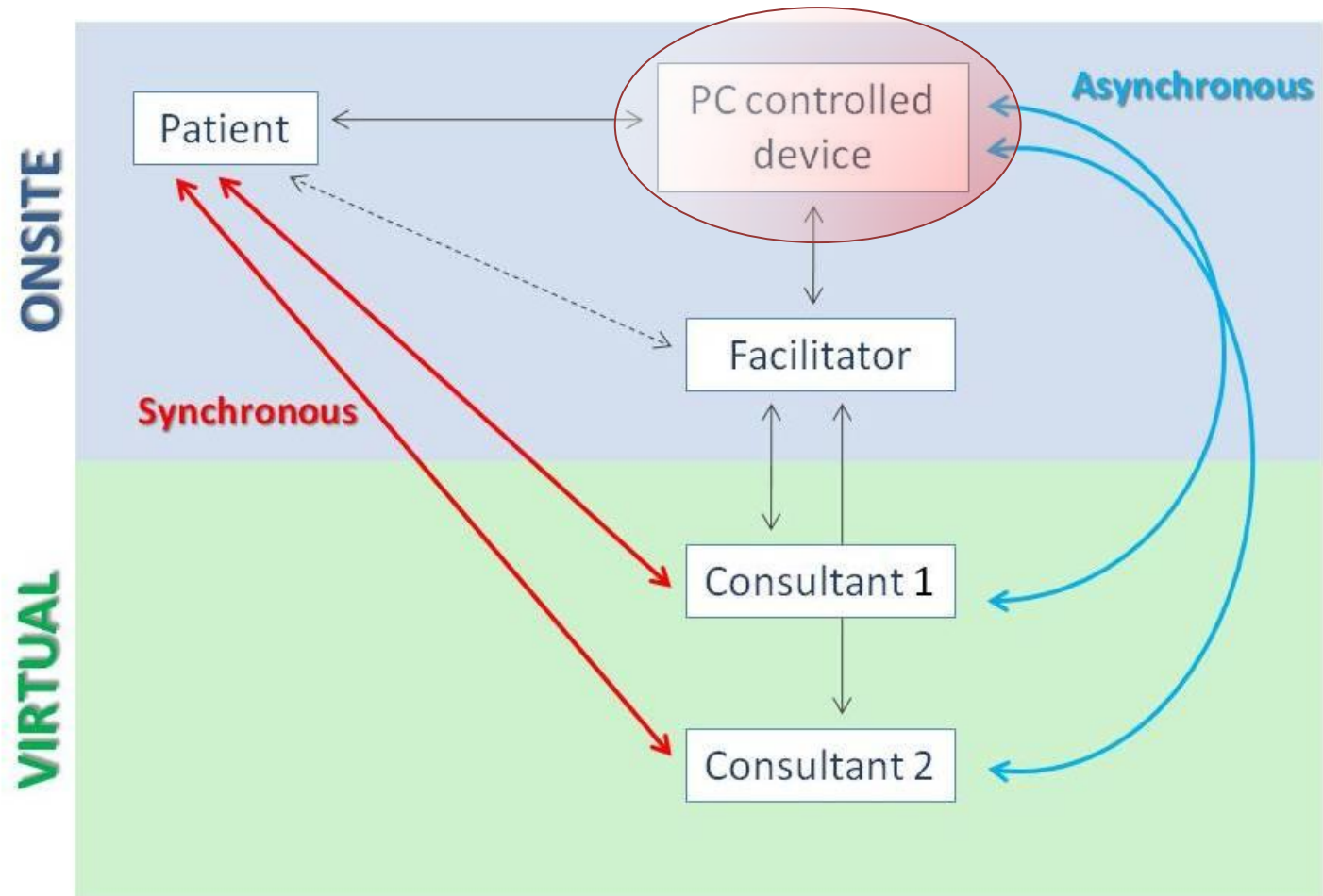


TELE-AUDIOLOGY CLINIC



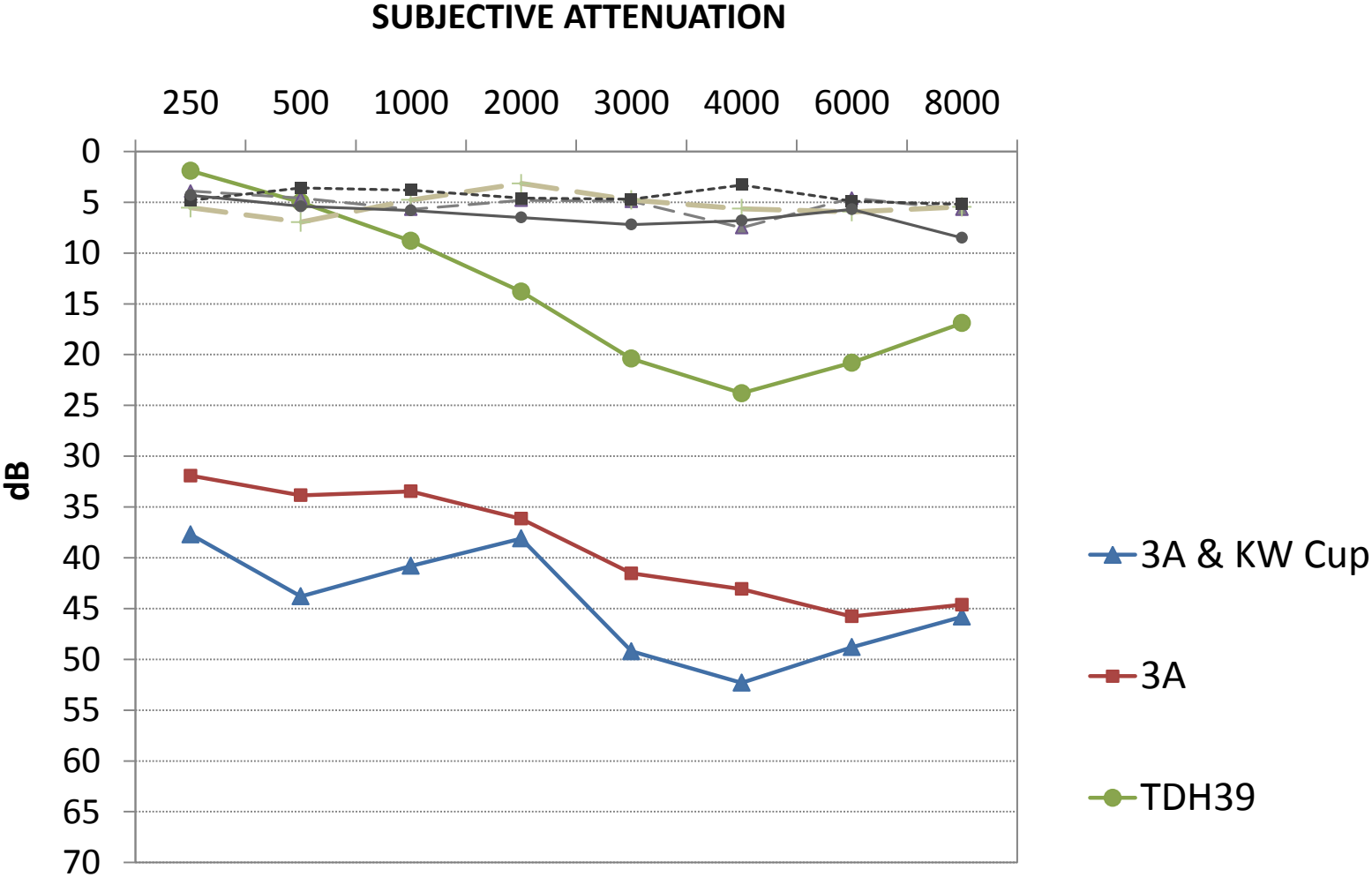


TELE-AUDIOLOGY CLINIC





AUDIOMETRY OUTSIDE A BOOTH?

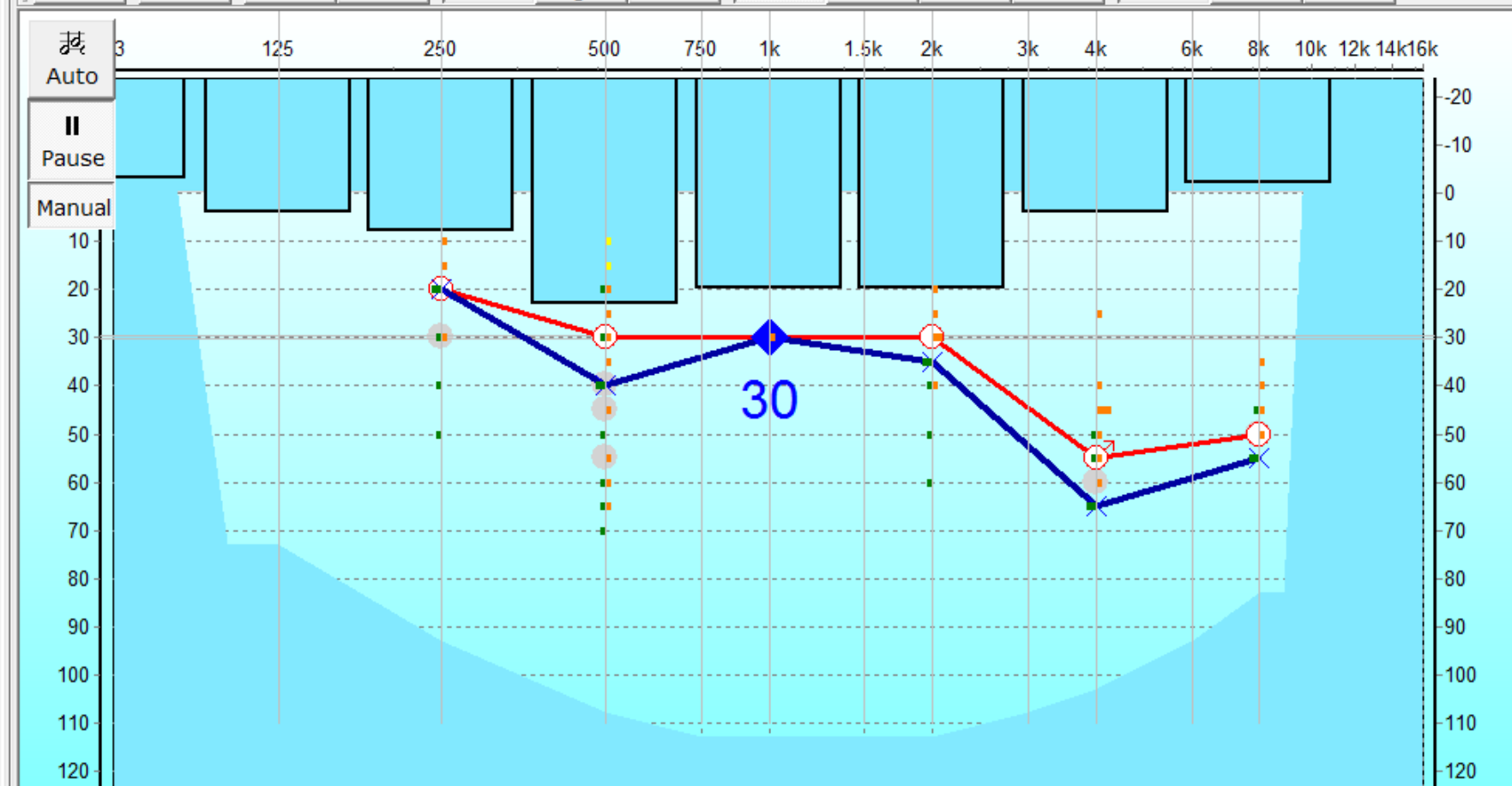


Jane Smith

[Export all patient data](#)
[Delete this patient](#)

Personal Data | Clinical Data | Media store | KUDUwave Pure Tone Audiometry

Max: -10



Advanced | View
 Basic | Compliance
 Hz **1000** **30** dBHL
 Noise in ear was compliant
 [Progress Bar] 3+
 Noise compliant
L 35 PTA **30** **R**

Soft ~40dB

AUDIOMETRY OUTSIDE A BOOTH?



AUDIOMETRY OUTSIDE A BOOTH?

- **Validation study**
- **Within-subject repeated measures** design comparing **air** (250 to 8000 Hz) and **bone** (250 to 4000 Hz) **conduction** thresholds in:
 - (1) **Natural school environments**
 - (2) **Sound-treated booth**
- **149** children (54% female) with an average age of **6.9 years** (SD 0.6; Range 5 – 8) from 2 schools.
- **Ave time** between tests **9.3 days** (± 8.4 SD) – tympanometry & otoscopy to confirm no transient middle-ear pathology

AUDIOMETRY OUTSIDE A BOOTH?

- **No significant differences** ($p > 0.01$) between the natural and audiometric booth environments within subjects between:
 - Thresholds** recorded in **natural and booth** environments for **air- and bone-conduction** audiometry
 - No of responses** to pure-tone presentations
 - Average reaction time**
- Almost all air- (**96%**) and bone-conduction (**97%**) threshold comparisons between the natural and booth test environments were within **0 to 5 dB**



AUTOMATED AUDIOMETRY?

• VOL. 16 NO. 5 • JUNE 2010 **TELEMEDICINE and e-HEALTH**

Hearing Assessment—Reliability, Accuracy, and Efficiency of Automated Audiometry

*De Wet Swanepoel, Ph.D.,^{1,2} Shadrack Mngemane,
B.Comm.Path.,¹ Silindile Molemong, B.Comm.Path.,¹ Hilda
Mkwanazi, B.Comm.Path.,¹ and Sizwe Tutshini, B.Comm.Path.¹*

Conclusions: Automated audiometry provides **reliable, accurate, and time-efficient hearing assessments** for normal-hearing and hearing-impaired adults.

AUTOMATED AUDIOMETRY?

Validity of Automated Threshold Audiometry: A Systematic Review and Meta-Analysis

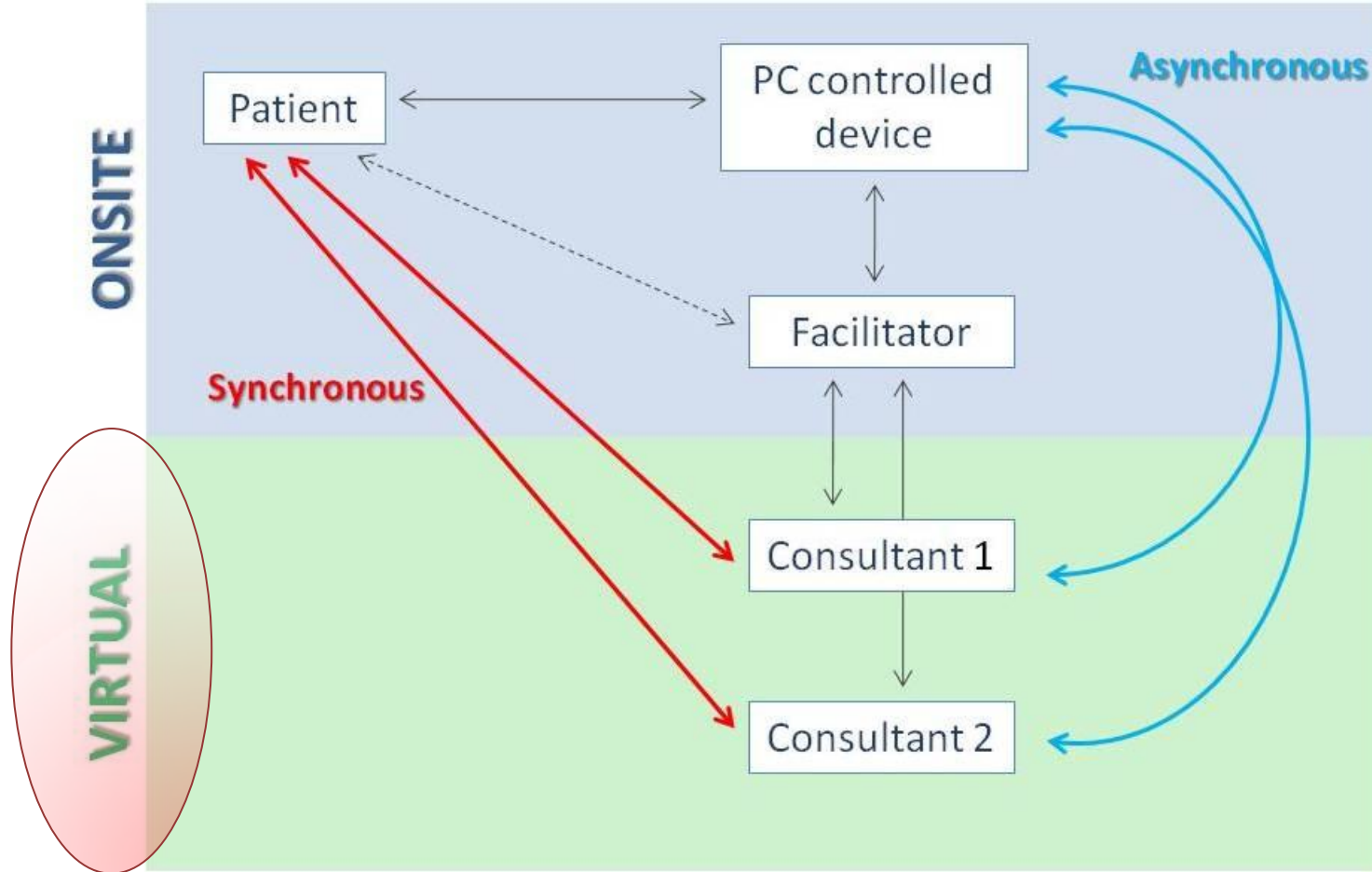
Faheema Mahomed,¹ De Wet Swanepoel,^{1,2,3} Robert H. Eikelboom,^{1,2,3} and Maggi Soer¹

Ear & Hearing 2013;34;745–752

Conclusions:

- **29** reports (method of limits and method of adjustment); 1956 - 2011.
- Meta-analysis **test-retest** and **accuracy** for automated audiometry was **within typical** test-retest variability for manual audiometry
- Provides an **accurate measure of hearing threshold**, but data limited for **(i) automated BC audiometry; (ii) children and difficult-to-test populations** and; **(iii) different types and degrees of hearing loss**

TELE-AUDIOLOGY CLINIC






TELE-AUDIOLOGY CLINIC


The screenshot shows a web browser window with the address bar displaying `41.76.212.236/emoyoserver/`. The browser's address bar includes navigation icons (back, forward, refresh) and utility icons (star, shield, plus, printer, download, menu). The main content area features a dark red header with the **eMOYO Server** logo and the tagline "GeoAxon - We take healthcare to the people". Below the header is a navigation menu with links for [Home](#), [eMoyo](#), [About](#), and [Admin Pages](#), along with a [\[Log In \]](#) button. The central content area contains a globe icon and the text "GeoAxon eMOYO Server". Three main functional areas are highlighted with icons: "Task Queue" (clipboard icon), "Patients" (couple icon), and "Reporting" (line graph icon). A footer bar at the bottom contains a [Contact Us](#) link.


41.76.212.236/emoyoserver/


eMOYO Server
GeoAxon - We take healthcare to the people

[Home](#) [eMoyo](#) [About](#) [Admin Pages](#) [\[Log In \]](#)

 GeoAxon eMOYO Server

 [Task Queue](#)

 [Patients](#)

 [Reporting](#)

[Contact Us](#)

eMOYO Server

GeoAxon - We take healthcare to the people

[Home](#) [eMoyo](#) [About](#) [Admin Pages](#)

Welcome DeWet.Swanepoel! [[Log Out](#)]



View/Interpret Test Results

Test Count: 686

[Back](#)

VTC

VC

Folder

Witkoppen

Select

Select

Run

Showing results for: Witkoppen

All

All

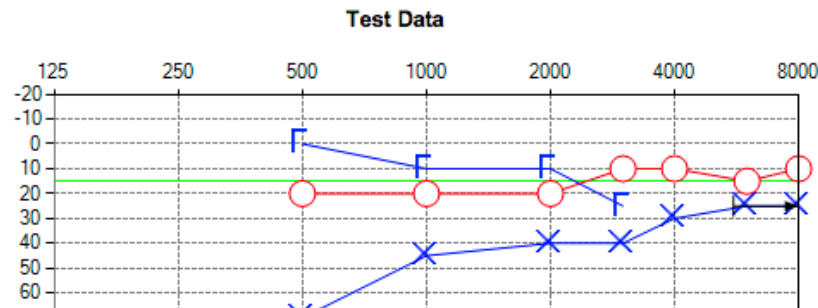
First 1 2 3 4 5 ... Last

View	VTC	Clinic	Test Date	Interpreted	Care Giver	Patient
	Witkoppen	Witkoppen	2012/10/03 09:10:38 PM	Violet		
	Witkoppen	Witkoppen	2012/10/03 03:17:11 AM	Violet		
	Witkoppen	Witkoppen	2012/10/02 11:34:24 PM	Violet		
	Witkoppen	Witkoppen	2012/10/02 11:12:28 PM	Violet		
	Witkoppen	Witkoppen	2012/10/01 02:07:25 AM	Violet		
	Witkoppen	Witkoppen	2012/10/01 01:40:56 AM	Violet		
	Witkoppen	Witkoppen	2012/10/01 01:21:33 AM	Violet		
	Witkoppen	Witkoppen	2012/09/25 04:27:14 AM	Violet		



Pure Tone Test: [REDACTED] - 2012/10/01 01:21:33 AM

[Back](#)



Interpretation

Add New Interpretation ...

DateCreated: 2012/10/09 09:23:42 AM
GeoClientName: De Wet, Swannepoel

REFERRALS FOR SYNCHRONOUS TESTING:

- Complex cases
- Difficult-to-test patients
- Queries regarding validity of results

geoaxon.kenya.ent.neri1 (207 108 135) - TeamViewer - Free license (non-commercial use only)

Actions | View | Audio/Video | File Transfer | Extras

et Swanepoel | Call | View | Tools | Help

Swanepoel | Add people

Take a snapshot | Full-screen

Current user: , registered with the HPCSA | Change user >>>

Patients | Export all patient data | Delete this patient

Personal Data | Clinical Data | Media store | KUDUwave Pure Tone Audiometry

Present | Clear | Mark | Delete | Left | Right | Bilat

Frequency (Hz)	Left Ear (dB)	Right Ear (dB)
125	15	15
250	15	15
500	15	15
1000	15	15
2000	25	25
4000	55	55

Advanced | View | Basic | Compliance

250 | 15 dBHL

Noise in ear was compliant | 3+

Noise compliant

22 | 17 R

Mark | X

Next >> | Cancel

Talk KUDUwave | Loud ~65dB | Talk

start | Skype™ - ayieko.jos... | De Wet Swanepoel | TeamViewer | emoyo | 13:38



- DOC
- NT De Wet 2012...vised
- DOC
- HPCSA Site visit...2012
- DOC
- HPCSA Site visit...2012
- DOC
- Marianne Theunissen
- PDF
- Marianne Theu...n.pdf
- PDF
- Bus_Route_Ma p_illo...3.pdf

REMOTE AUDIOMETRY?

RESEARCH

Original article

▶ Intercontinental hearing assessment – a study in tele-audiology

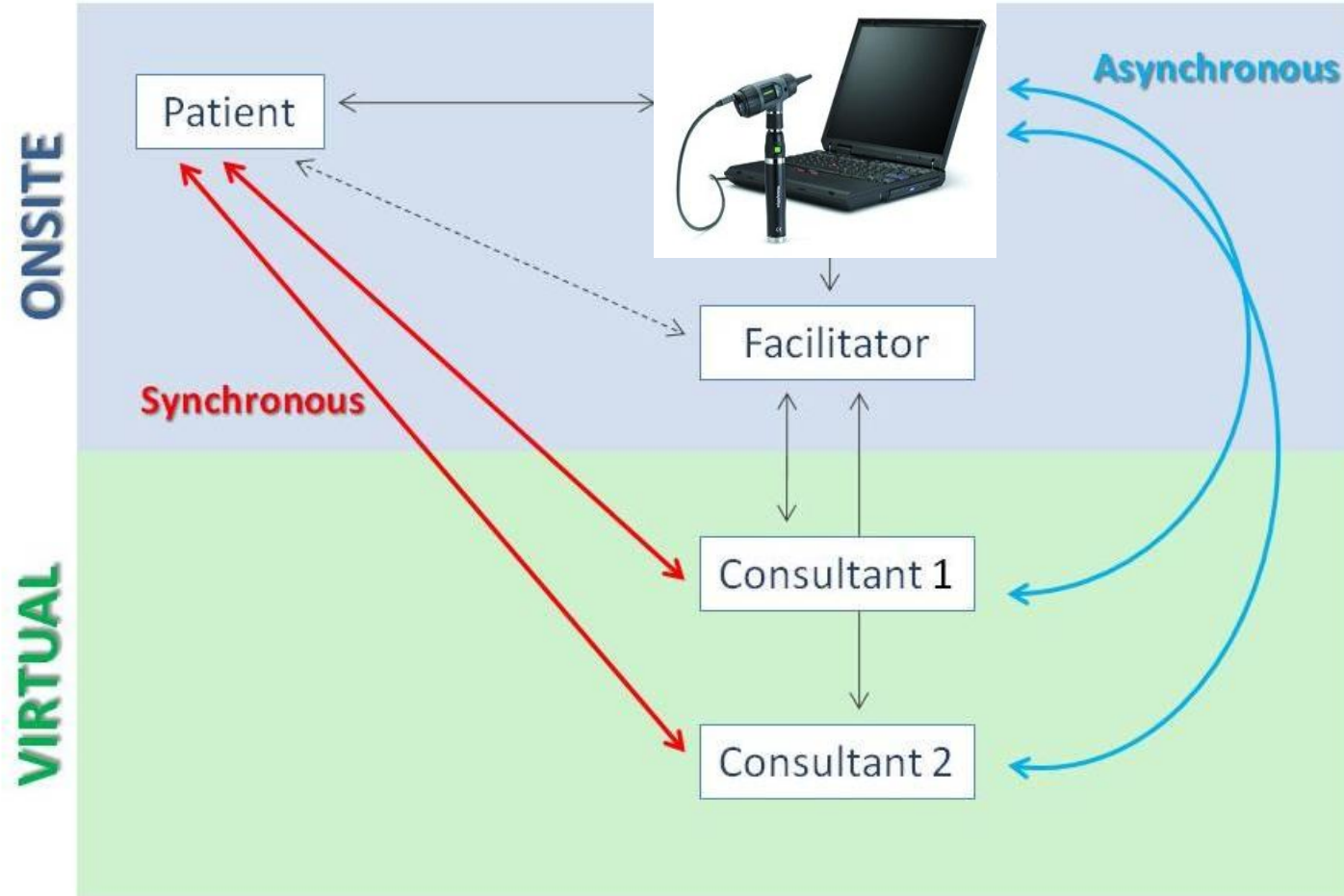
De Wet Swanepoel*‡, Dirk Koekemoer† and Jackie Clark‡§

*Department of Communication Pathology, University of Pretoria, Pretoria; †Research and Development Department, GeoAxon, Pretoria, South Africa; ‡Callier Center for Communication Disorders, University of Texas at Dallas, Texas, USA; §Department of Speech and Hearing Therapy, University of the Witwatersrand, Johannesburg, South Africa

Journal of Telemedicine and Telecare 2010; **16**: 248–252

Conclusions: There were **no clinically significant differences** between the results obtained by **remote intercontinental audiometric testing** and conventional **face-to-face audiometry**.

TELE-AUDIOLOGY CLINIC



REMOTE DIAGNOSIS OF EAR DISEASE

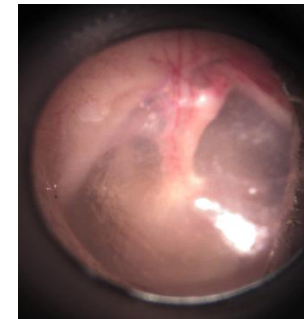
Background

- Global burden from **chronic OM** affect **65 – 330 million**
- **India & sub-Saharan Africa** account for most deaths from **OM**
- **COM** – 1) **risk of hearing loss** and 2) **life-threatening complications** (e.g. meningitis, brain abscesses)
- Largely **preventable** and **effective** medical management
- **Early detection** and treatment at primary health care can **reduce long-term morbidity** and **mortality**

BUT - **Poor access** to specialist personnel **limit diagnosis** and appropriate **treatment**

REMOTE DIAGNOSIS OF EAR DISEASE

- **Aim:** To evaluate the **effectiveness** and **accuracy** of **video-otoscopy** recordings by a trained **non-professional** for remote **diagnosis** of **ear disease** in children
- **Design:** Within-subject comparative design
- **Subjects:** **140** unselected children (**2 – 15** yoa; mean 6.4 ± 3.5 yoa; 44.3% female) attending a PHC
- **Context:**



REMOTE DIAGNOSIS OF EAR DISEASE

Equipment and procedures:





REMOTE DIAGNOSIS OF EAR DISEASE

Concordance of otomicroscopy and remote video-otoscopy

	Onsite diagnosis n = 272 ears	Remote diagnosis n = 269 ears	
	Otologist (%)	Otologist (%)	
		Review 1	Review 2
Normal	75.8	58.4	62.1
Otitis media:	16.5	16.7	14.5
<i>AOM</i>	0.7	0.0	0.7
<i>CSOM</i>	4.8	6.7	6.3
<i>SOM</i>	11.0	10.0	7.5
Undetermined	7.7	24.9	23.4

R1 Kappa
= 0.702

R2 Kappa
= 0.740

**Substantial
agreement**

Sens / Spec = 78% / 95%

Intra-rater diagnosis Kappa – 0.773

REMOTE DIAGNOSIS OF EAR DISEASE

CONCLUSIONS

- A non-professional, with no health care training, can **be trained to acquire** adequate video otoscopic recordings for remote otologic diagnosis
- Remote diagnosis accuracy is similar to inter- and intra-rater agreement previously reported
- Accompanied **with audiometric data** it can be a valuable **diagnostic tool** to underserved populations
- **Video recordings** improved diagnostic utility above images
- More experience may improve quality of recordings

CONCLUSION

- Rapidly changing world
- **Hearing loss and ear disorders** prevalent with inadequate human resources to meet **demands**
- Continued **growth** in **technology** and **connectivity** will change the way in which we deliver services. E.g.
 - *Remote hearing assessment*
 - *Remote ear diagnosis*
- Promise of **reaching** more patients, and especially those in **underserved** areas, **more effectively** (time and cost)

