

Tele-audiology monitoring for MDR-TB: a national programme

Dirk Koekemoer (MD)

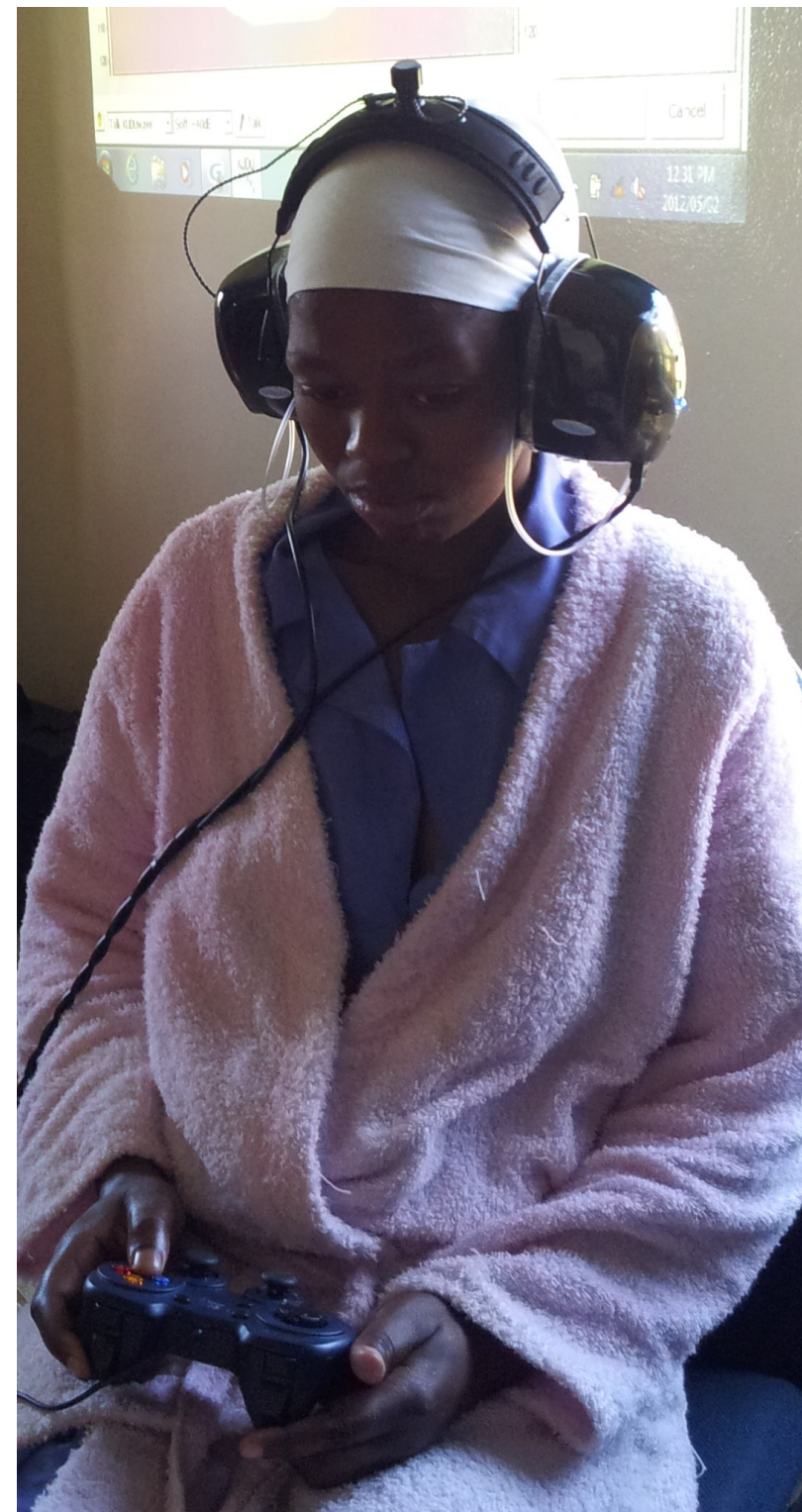
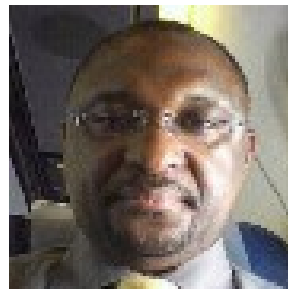
Chairman

GeoAxon Tele Health

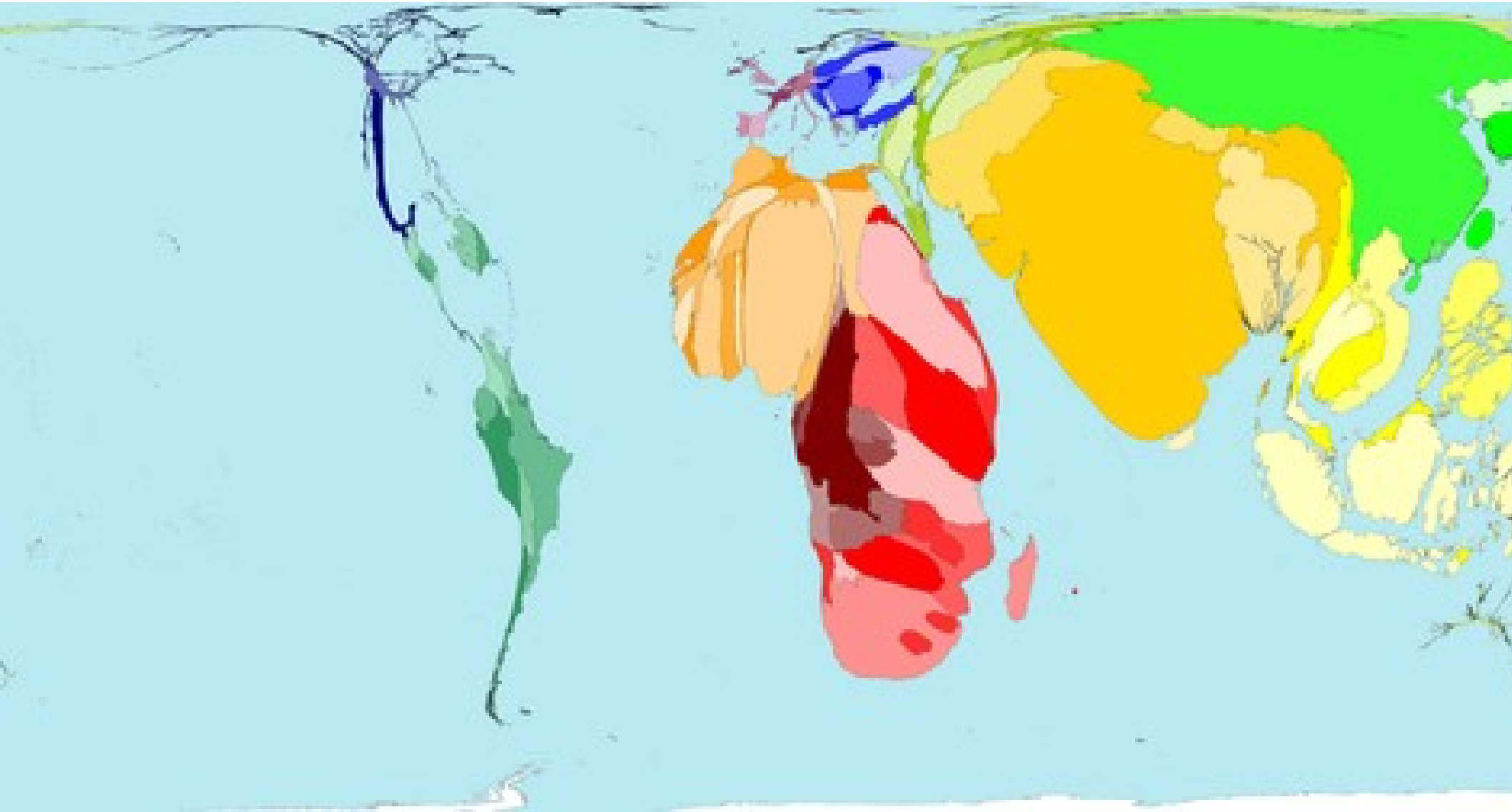
Norbert Ndjeka (MD)

Director MDR-TB

National DoH



South Africa is the third highest tuberculosis (TB) burden country in the world, lagging behind two countries, China and India, significantly larger populations than ours.



DR, MDR and XDR TB

- DR TB (Drug Resistant)
 - Rx Streptomycin
- MDR TB (Multi DR)
 - Rx Kanamycin (Capreomycin)
- XDR TB (Extreme DR)
 - Rx Kanamycin (Capreomycin) – lengthy treatment
- Patients are on these injectables for months
- 5000 patients per month need to be monitored for ototoxicity in South Africa (Epert ↑ numbers)



Ototoxicity hearing loss stats

- Kanamycin: between 17% - 41%
- DOTS-Plus initiative: 12%
- Global magnitude ototoxicity for children: 3-4%
- Injectable aminoglycosides are by far the most common cause of hearing impairment due to ototoxicity
- The global resurgence of tuberculosis is leading to greater use of streptomycin (ZA is different)

• Aminoglycoside-Induced Hearing Loss in Humans. Robert E Brummetti

<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC284232/pdf/aac00377-0013.pdf>

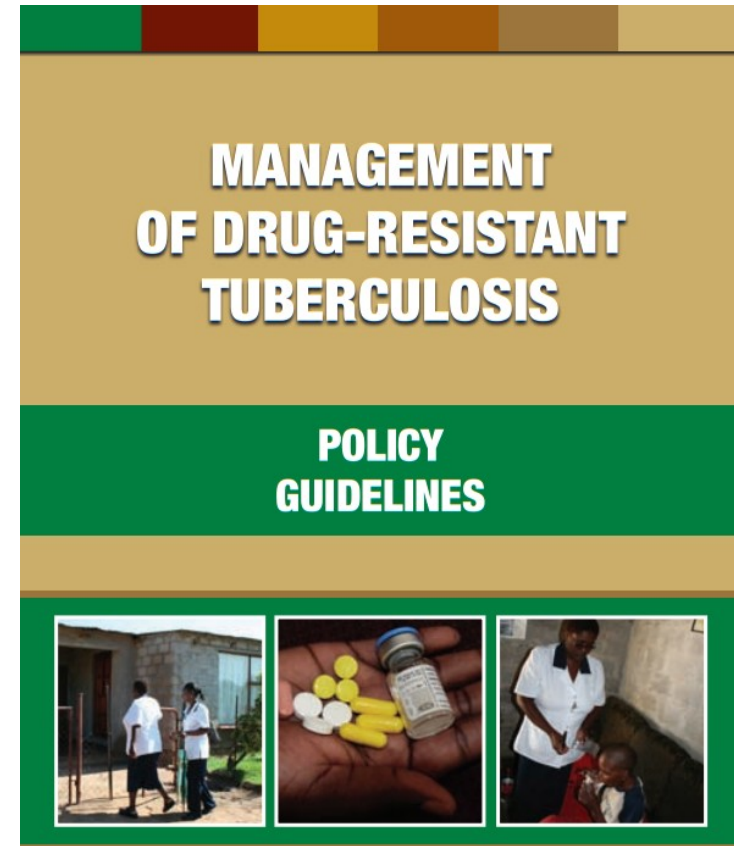
• Vathanson E et al. Adverse events in the treatment of multidrug-resistant tuberculosis: results from the DOTS-Plus initiative. International Journal of Tuberculosis and Lung Disease, 2004, 8(11):1382-1384.

• http://www.who.int/pbd/deafness/ototoxic_drugs.pdf

National guidelines

- Baseline hearing test
- Monthly screening (~ 8 times)
- Exit when injectable stopped
- (3 and 6 months after Exit)

Average ~12 tests per patient



health

Department:
Health
REPUBLIC OF SOUTH AFRICA

What can be done?

Say no to the historic perception of “Deaf or Die”

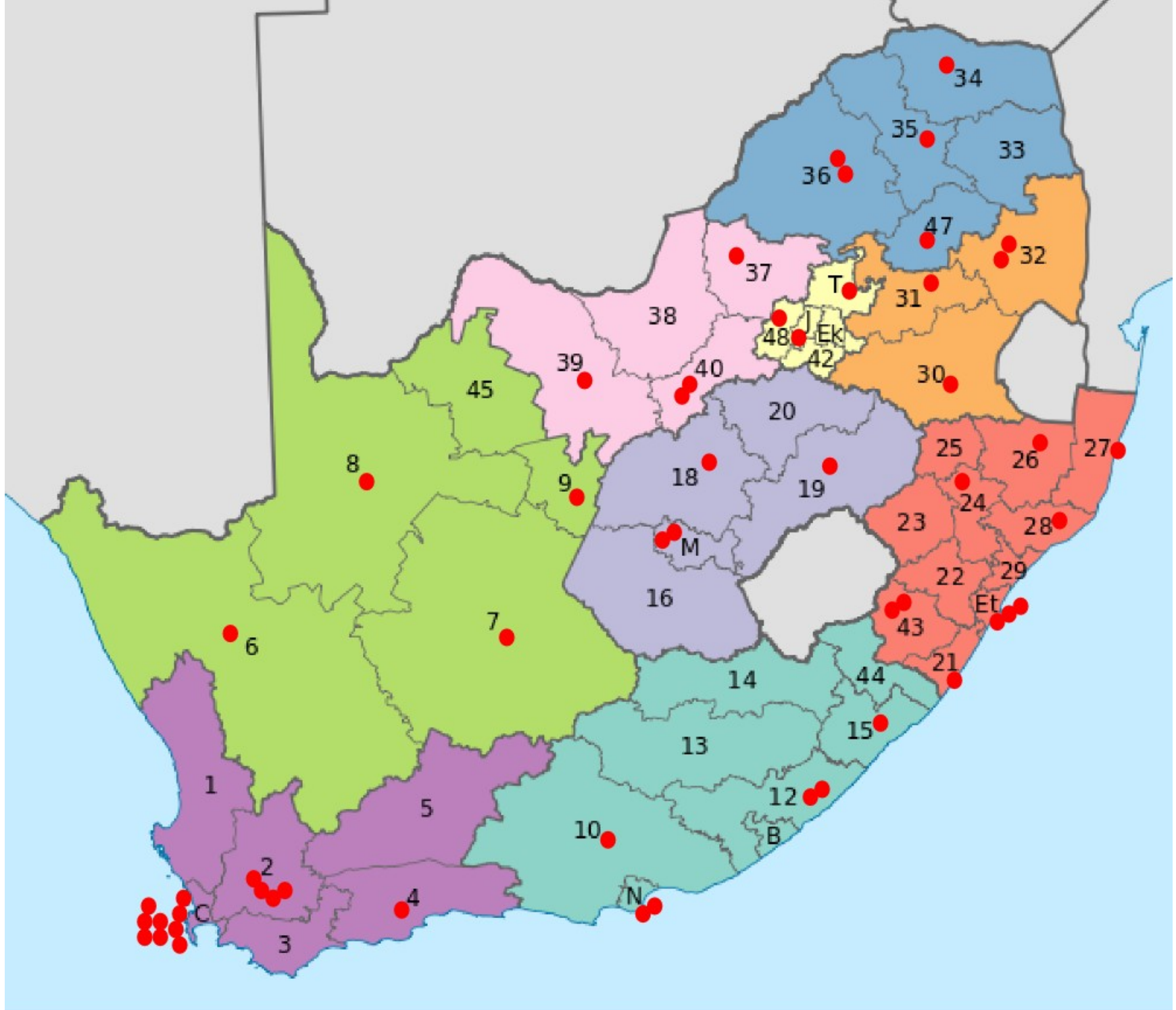
- Decrease dosage
- Inject every alternating day
- Replace the culprit drug with 2 other drugs
- Change Kanamycin to Capreomycin that is less ototoxic
- Regular monitoring
- Walk the road with the patient if he goes deaf

All this will lead to better outcomes with less patients defaulting that leads to XDR-TB

Dilemmas of monitoring for ototoxicity

- Ototoxic hearing loss is irreversible
- Patients are spread out all over SA
- The more remote the more TB
- ↑ decentralised management of MDR-TB
- Baselines within 72 hours after first injectable
- Only around 500 practicing audiologists in SA
- >70% of patients have HIV (ARV ototoxicity risk)

It is too late when the doctor starts speaking up so that the patient can hear



54 ● MDR-TB hospitals and decentralised sites in South Africa



health

Department:
Health
REPUBLIC OF SOUTH AFRICA



We must take health care to the peoples of our country

GE**Axon**

We take healthcare to the people

Currently

- Patient in sound booth
- Headset
- Audiometer
- On site calibrations
- Audiologist
- Site bound



KEEP THE DOOR CLOSED

MDR TB

WEAR MASK AT ALL TIMES



What can one do to solve the problems?

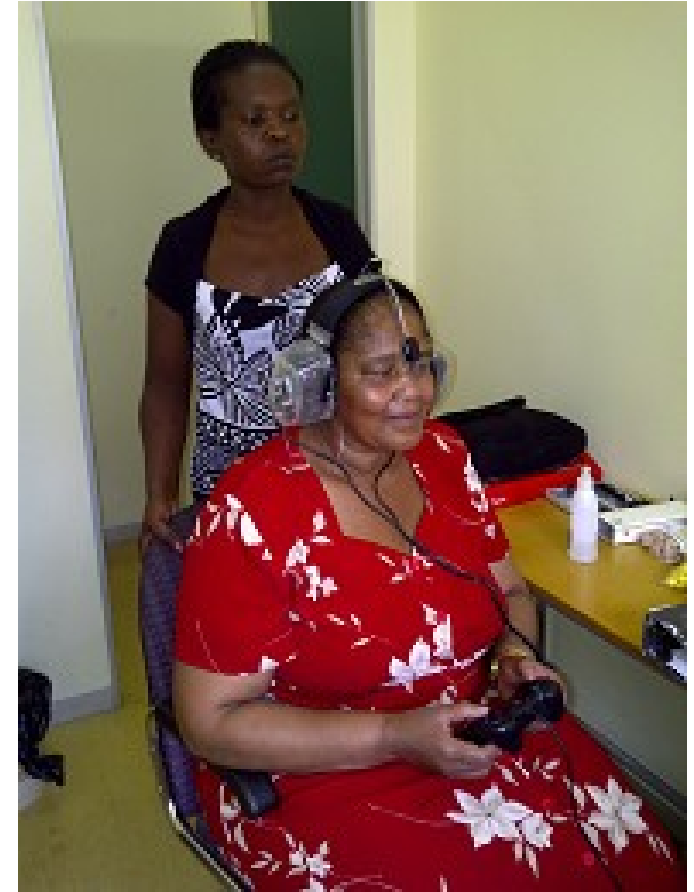
Open air hearing tests!

Automated test procedures

Available 8 hours 5 days a week

Trust the test done

Tele-Audiology interpretations



*Technology is the only hope for a rapid
widespread impact*

1.8 kg

Clinical audiometer (air,
bone and masking)

+

Extended HF (9-16kHz)

+

Insert ear phones

+

“Mobile Sound booth”

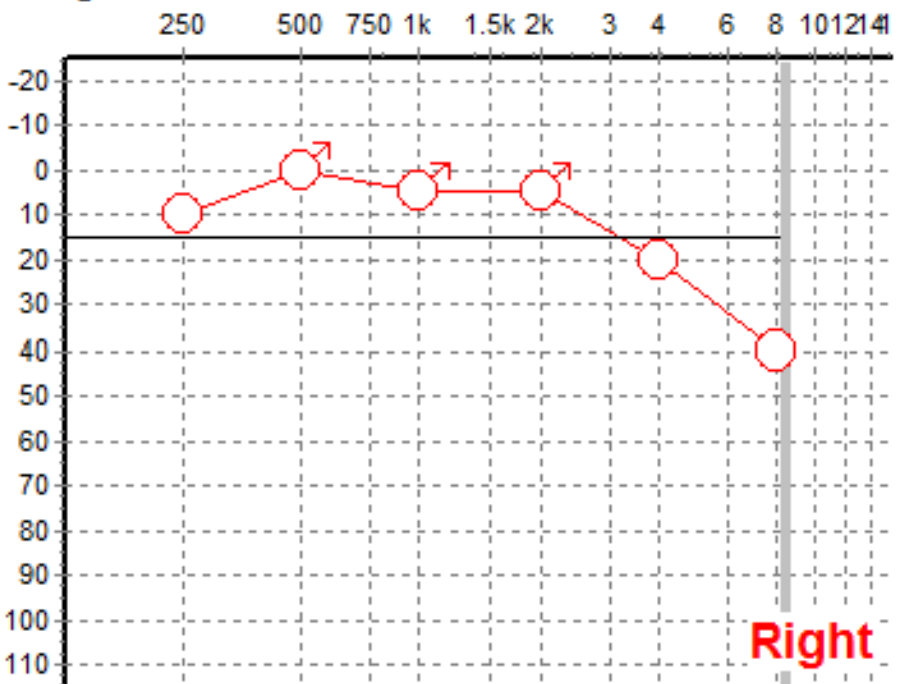
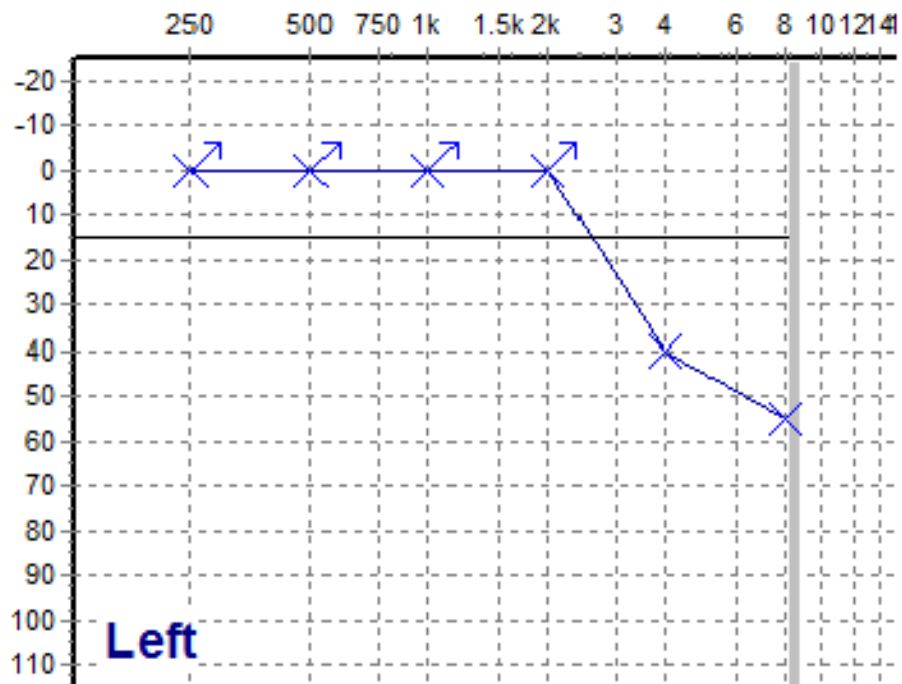
+

“Virtual Audiologists”
(Tele-Audiology)



Country of passport:

Patient Signature



125 250 500 1k 2k 3k 4k 6k 8k 9k 11.2 12.5 14k 16k

125 250 500 1k 2k 3k 4k 6k 8k 9k 11.2 12.5 14k 16k

0 0 0 0 40 55
 -10 -7 0 -18 -11 -22
 -19 -18

Air thresholds

Noise in ear canal
 Noise for threshold-5dB
 Maximum masking

10 0 5 5 20 40
 -13 -6 -16 -11 -13 -14
 -2 -9 -10 -17 -17

Bone thresholds

Noise in ear canal
 Noise for threshold-5dB
 Maximum masking

Bone unmasked

Noise in ear canal
 Noise for threshold-5dB

ZAR occupational health PLH
 OccHealth category
 Binaural impairment

DSHL
 PTA 0
 % loss
 Low sum 0
 High sum

Response stats N 35
 Response stats Mean 589
 Response stats Std.Dev. 272

30
 601
 174

DSHL
 PTA 3
 % loss
 Low sum 10
 High sum

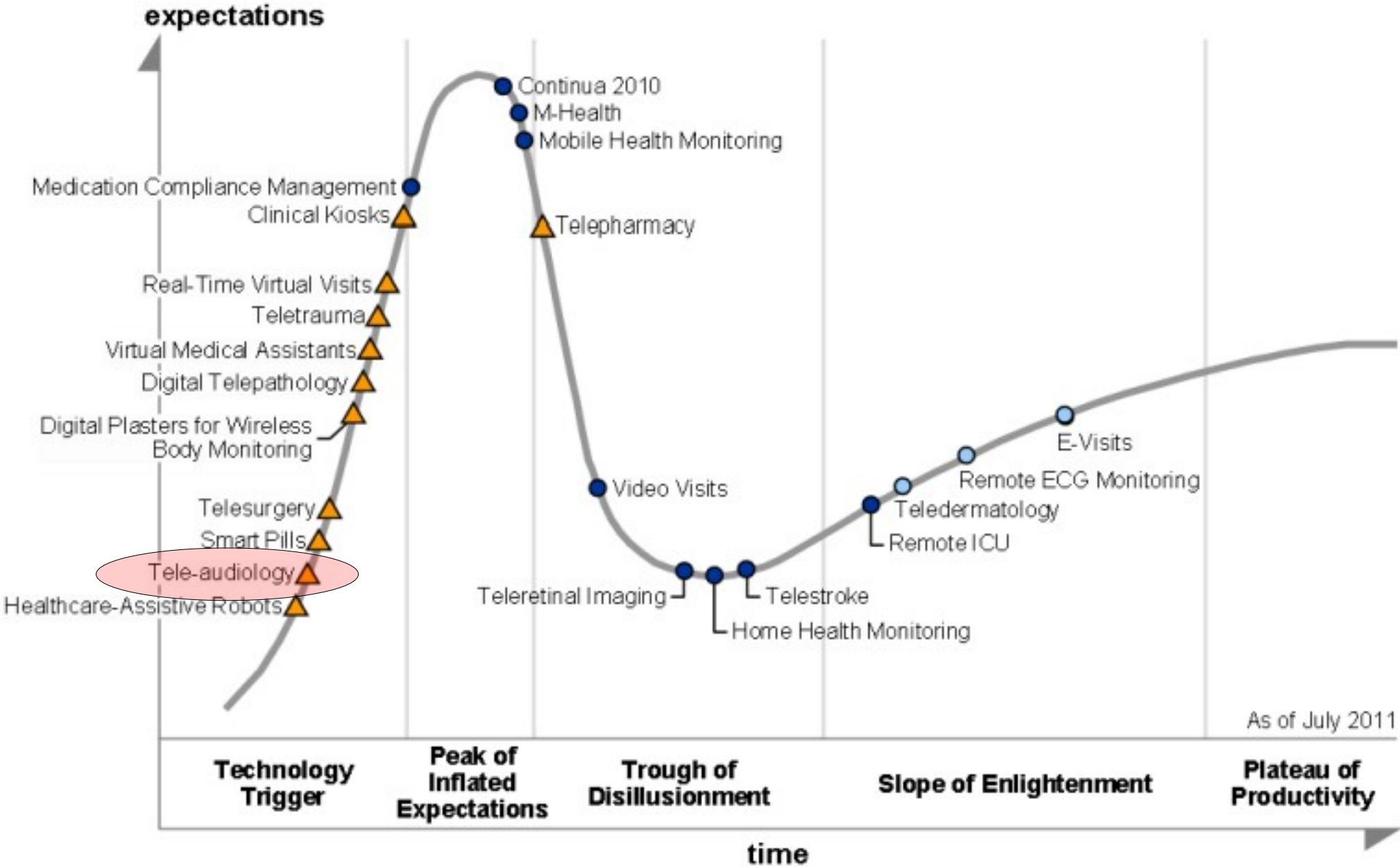
Total compliant responses (green): 66
 Total compliant noise presentations without responses (orange): 28
 Total non-compliant ambient noise presentations (yellow): 2
 Noisy event index [Yellow / (Green + Orange) %]: 2

False positive response count: 2
 True positive response count: 66
 False positive response % (grey): 3

Number of frequencies where the KUDUwave could not test to the softest thresholds due to noisy ambient conditions: 7

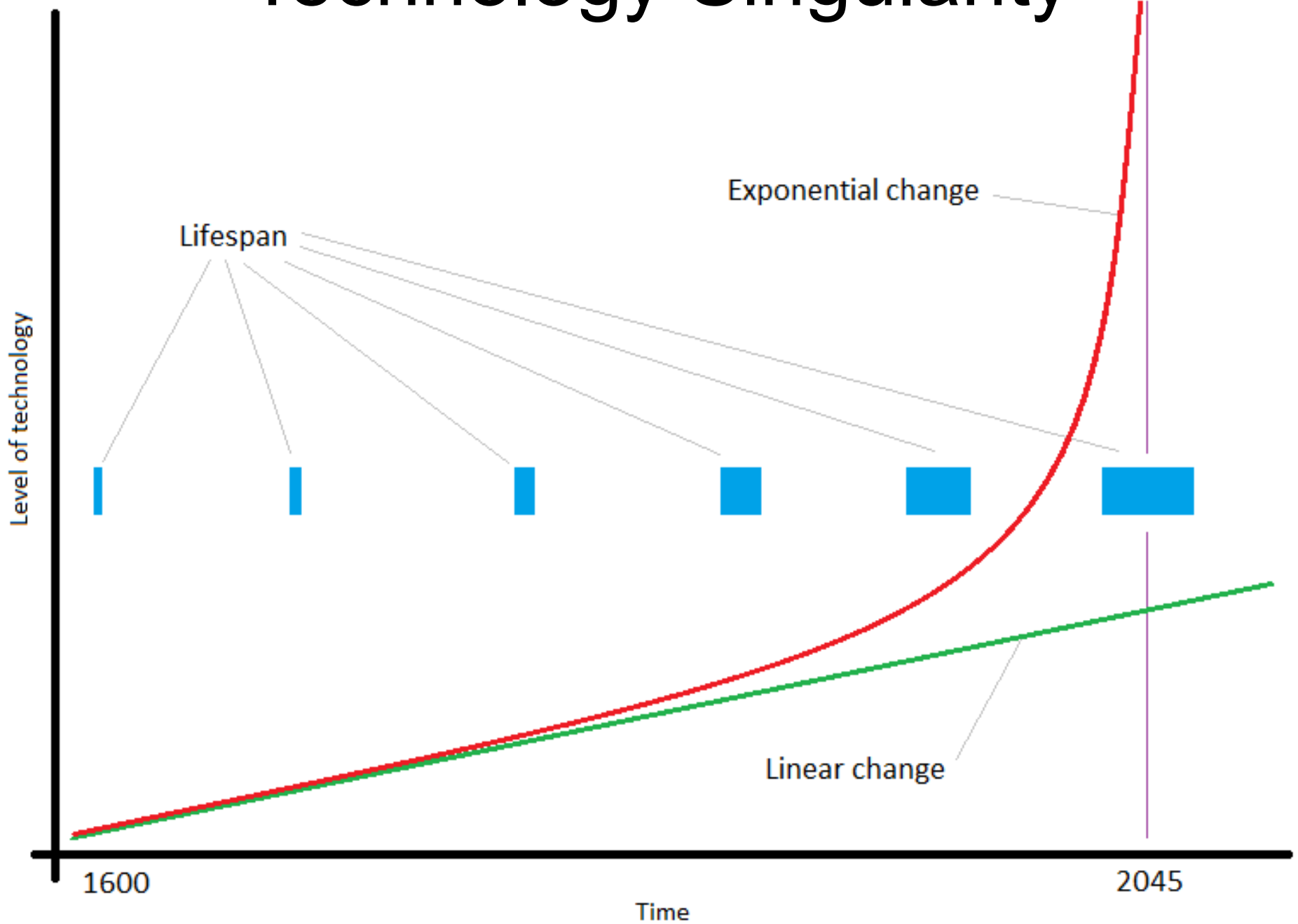
Difference in dB between the first threshold tested and the repeat threshold at the end of the test:

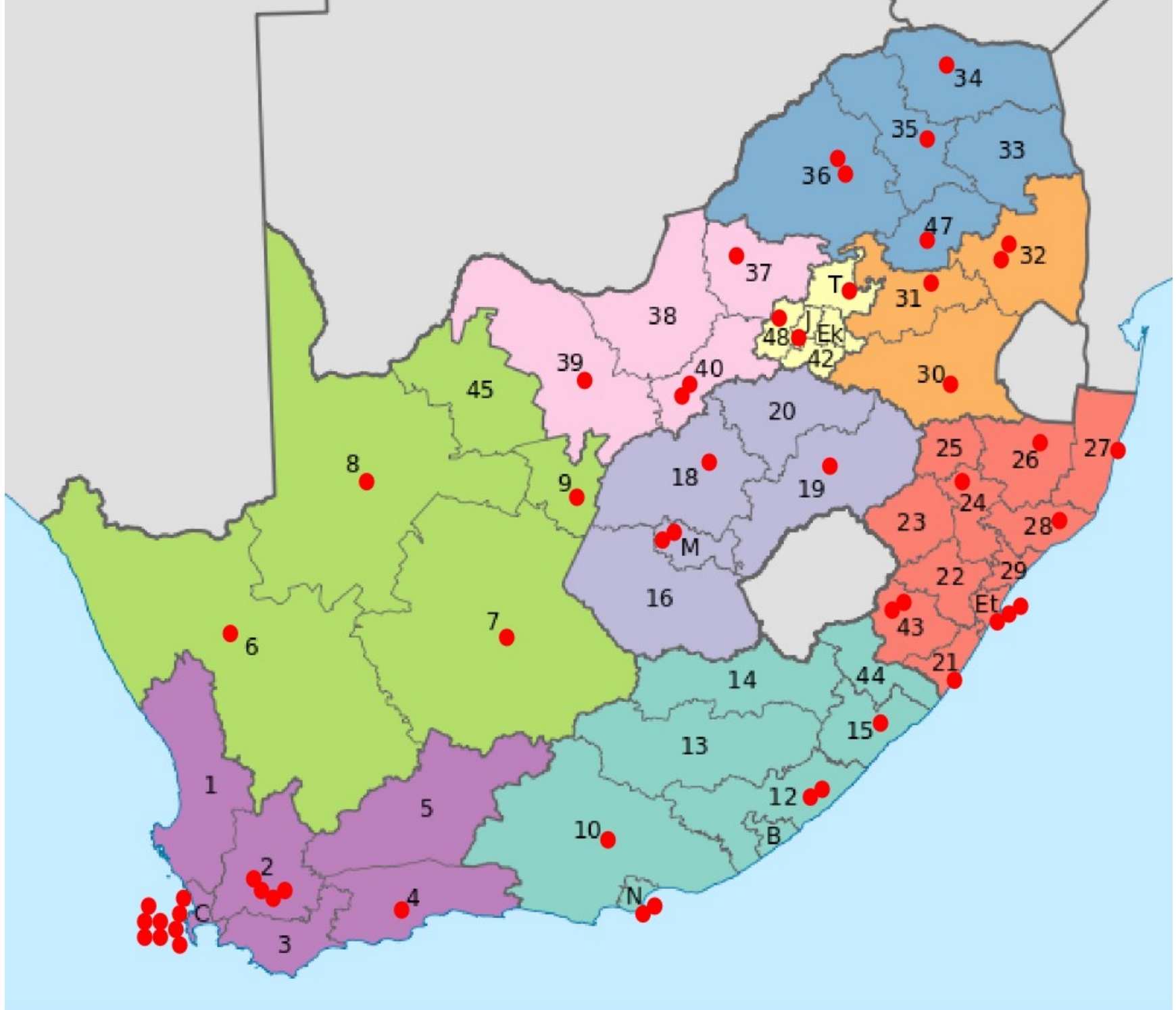
Figure 1. Hype Cycle for Telemedicine, 2011



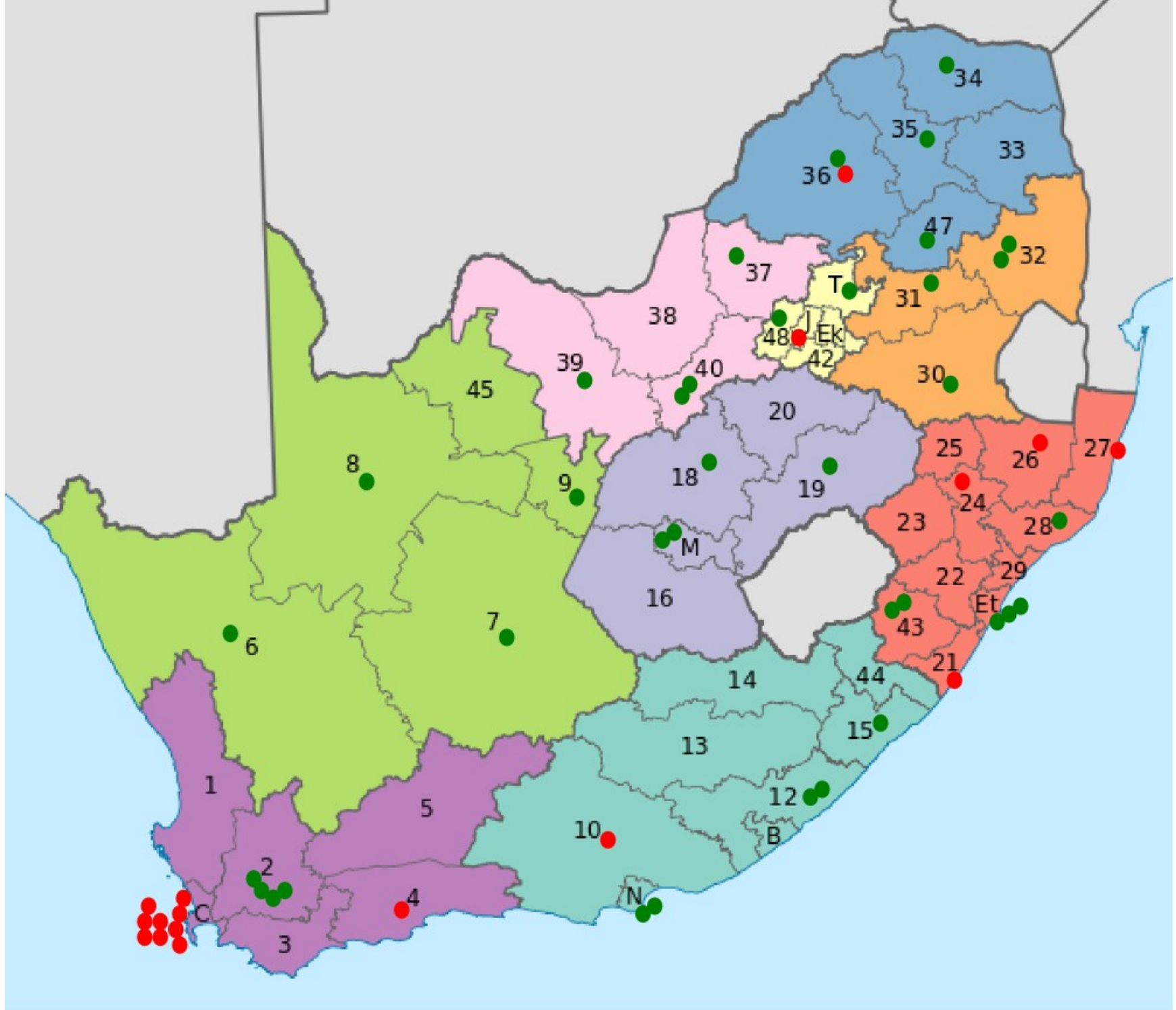
As of July 2011

Technology Singularity





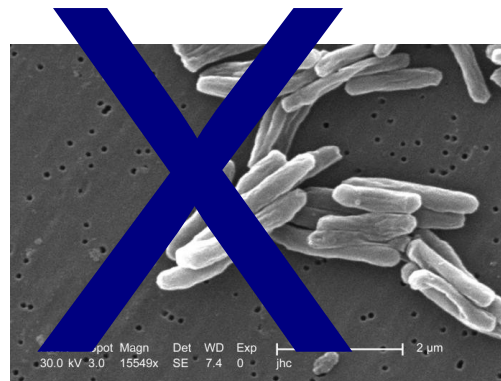
54 ● MDR-TB hospitals and decentralised sites in South Africa

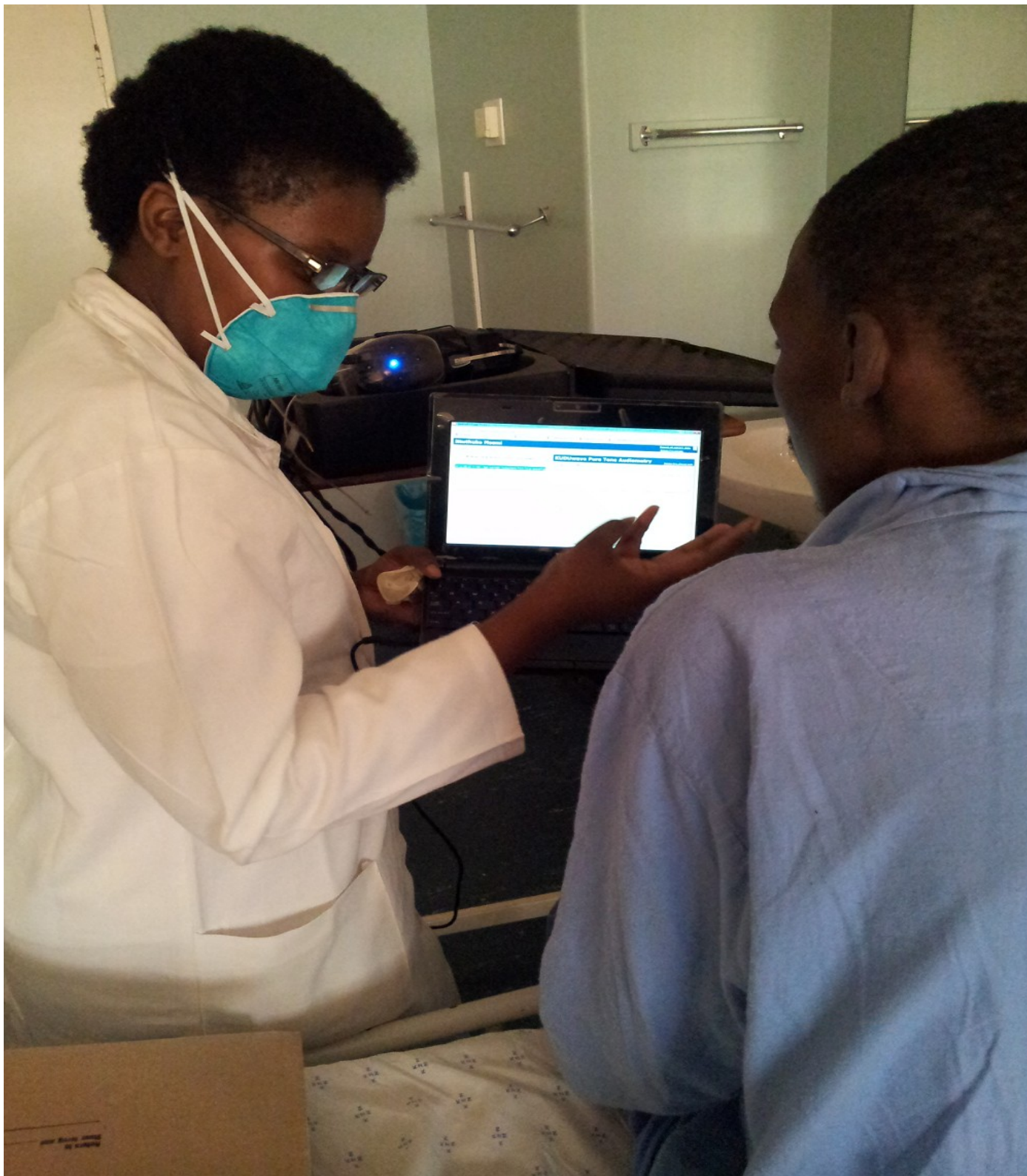


38 ● MDR-TB hospitals and decentralised sites with Kuduwaves

Can test virtually anywhere

- Hospital bed testing
- Take with you to decentralised clinics
- ↓ risk of cross infection and ↓ claustrophobia
- Test patient with oxygen mask on his face
- Wheel chair not needed





Virtually anybody can “do” the test

- Windows software
- Easy to use
- Automatic
- Facilitator
 - Nurses / doctor
 - Admin staff

*Interpretations
centralised*





Audiologist

VAC
(Virtual Audiology Centre)



TWS
(Tele-audiology
WorkStation)

Decentralised MDR-TB site

TWS
(Tele-audiology
WorkStation)

MDR TB
OPD



MDR TB Hospital



Roll-out update

- 38 sites in total – roll out started in August 2012
- 28 training sessions to train all 38 sites
 - ~30 people attended each session
 - 2 facilitators practical trained per site
 - All audiologists who attended were trained
- 24 sites are already functional
- 14 sites are still being rolled out – re-training needed
- 15 sites audiologists are using the equipment themselves
- 3 sites Drs and Srs are doing the tests and interpretations
- 10 sites centralised Asynchronous testing and interpretations
- 7 sites provincial audiologists does Asynchronous interpretations
- 3 sites GeoAxon interprets (561 interpretations to date)

Next phase coming up

- Connectivity – pay as you go is virtually impossible to project manage
 - We are in the process of converting all to our APN
- Re-training of the users of the equipment (facilitators) at 15 sites
- GeoAxon is hoping that the University of Pretoria can do some interpretations for the DoH instead of ourselves
- In a few months there will be in total ~23 functional Asynchronous Tele-Audiology sites

St. Margarets Hospital





No Audiologist
GPRS Connectivity
6 nurses trained
Hospital IT specialist is project champion

Callie

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

Personal Data | Clinical Data | KUDUwave Pure Tone Audiometry

Connected to the Kuduwave

Custom settings

Auto Air and Bone [Octaves 250Hz to 8kHz - SANS 10182]

Auto Quick screening [Min 15dBHL - 500Hz to 2kHz - SANS 10182]

Auto Quick screening [Min 20dBHL - 500Hz to 2kHz - SANS 10182]

Ototoxicity Auto Baseline [250Hz to 16kHz - SANS 10182]



Ototoxicity Auto Exit [250Hz to 16kHz - SANS 10182]

Ototoxicity Auto Screening [1kHz to 16kHz - SANS 10182]

SANS 10083 Baseline - Auto Occ. Health [Min 0dBHL]

SANS 10083 Baseline - Auto Occ. Health [Min 10dBHL]

SANS 10083 Exit - Auto Occ. Health [Min 10dBHL]

 Create a new Macro (Test protocol) Delete selected Macro


Unlock

Days remaining before this software locks: 51



Talk Kuduwave


Soft ~40dB

 Talk Show settings

Next >>

Cancel

Current user: Dr Dirk Koekemoer, registered with the HPCSA

[Change user](#)[Setup >>>](#) Patient list

Callie

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Personal Data | Clinical Data | KUDUwave Pure Tone Audiometry

Start page

 Simulate a sound booth (Monitor the ambient noise)

Maximum permissible ambient sound pressure levels for Air Conduction and Occluded Bone Conduction to test accurately to 0 dBHL

			125	250	500	1000	2000	4000	8000 Hz
<input type="radio"/>	ANSI/ASA S3.1** for Kuduwave headset	dB SPL	58	58	55	49	46	54	52
<input type="radio"/>	SANS-10182* screening for Kuduwave headset	dB SPL	74	74	61	56	55	65	64
<input checked="" type="radio"/>	SANS-10182** diagnostic for Kuduwave headset	dB SPL	56	56	59	56	55	65	64
<input type="radio"/>	BS 6655*** (EN 26189 or ISO 6189) for Kuduwave	dB SPL	69	68	57	52	49	58	58

* South African National Standard: The measurement and assessment of acoustic environments for audiometric tests


** American National Standards Institute: Maximum Permissible Ambient Noise Levels for Audiometric Test Rooms

*** British Standard: Specification for Pure tone air conduction threshold audiometry for hearing conservation

 Simulate an audiometer (Maximum and minimum thresholds)

Talk Kuduwave ▾

Soft ~40dB ▾

 Talk

<< Back

Next >>

Cancel

Callie

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Personal Data

Clinical Data

KUDUwave Pure Tone Audiometry

Start page

Extended high frequencies

	8k	9k	10k	11.2k	12.5k	14k	16k	Minimum
Extended high frequencies for Air*	93	88	N/A	73	78	63	48	-20

* IEC 60645-4 classification

Threshold seeking method

Manual

Automatic setup:

Shortened Ascending method (ISO 8253-1)

Type of tone

Pure tone

Tone duration

500 milli seconds (ms)



Talk Kuduwave

Soft ~40dB

Talk

<< Back

Next >>

Cancel

Callie

Setup for automatic testing page

Frequencies to test (Hz):

Automatically add BC if AC \geq dBHL for:

- Left Air
- 125
 - 250
 - 500
 - 750
 - 1k
 - 1.5k
 - 2k
 - 3k
 - 4k
 - 6k
 - 8k
 - 9k
 - 11.2k
 - 12.5k
 - 14k
 - 16k

- Right Air
- 125
 - 250
 - 500
 - 750
 - 1k
 - 1.5k
 - 2k
 - 3k
 - 4k
 - 6k
 - 8k
 - 9k
 - 11.2k
 - 12.5k
 - 14k
 - 16k

- Left Bone
Masked
- 250
 - 500
 - 750
 - 1k
 - 1.5k
 - 2k
 - 3k
 - 4k

- Right Bone
Masked
- 250
 - 500
 - 750
 - 1k
 - 1.5k
 - 2k
 - 3k
 - 4k



-
-
-
-
-
-
-
-

Repeat the first frequency again after the test completed

Default test order:



Talk Kuduwave

Soft ~40dB

Talk

<< Back

Next >>

Cancel

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[Setup >>>](#)

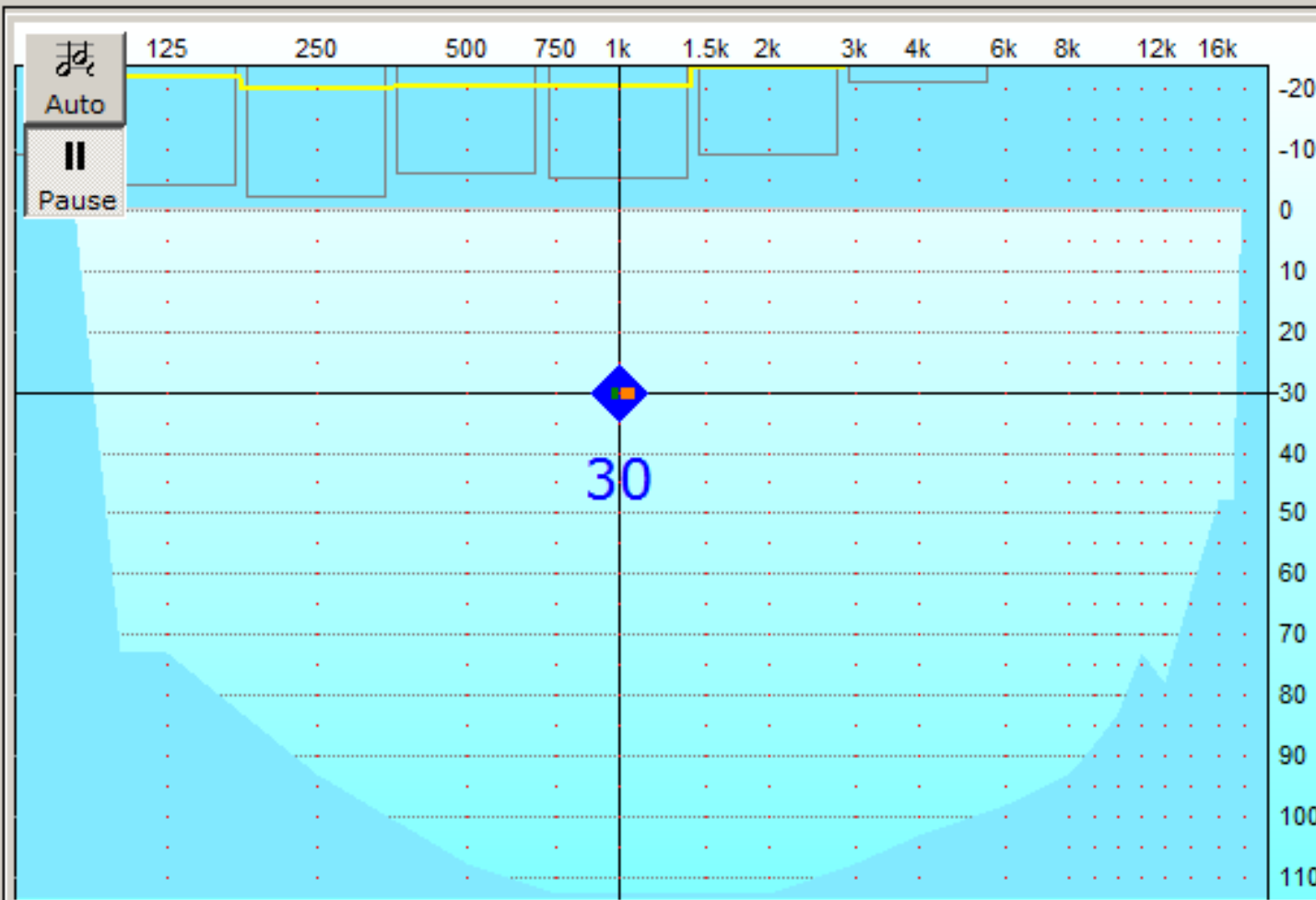
Patient list

Callie

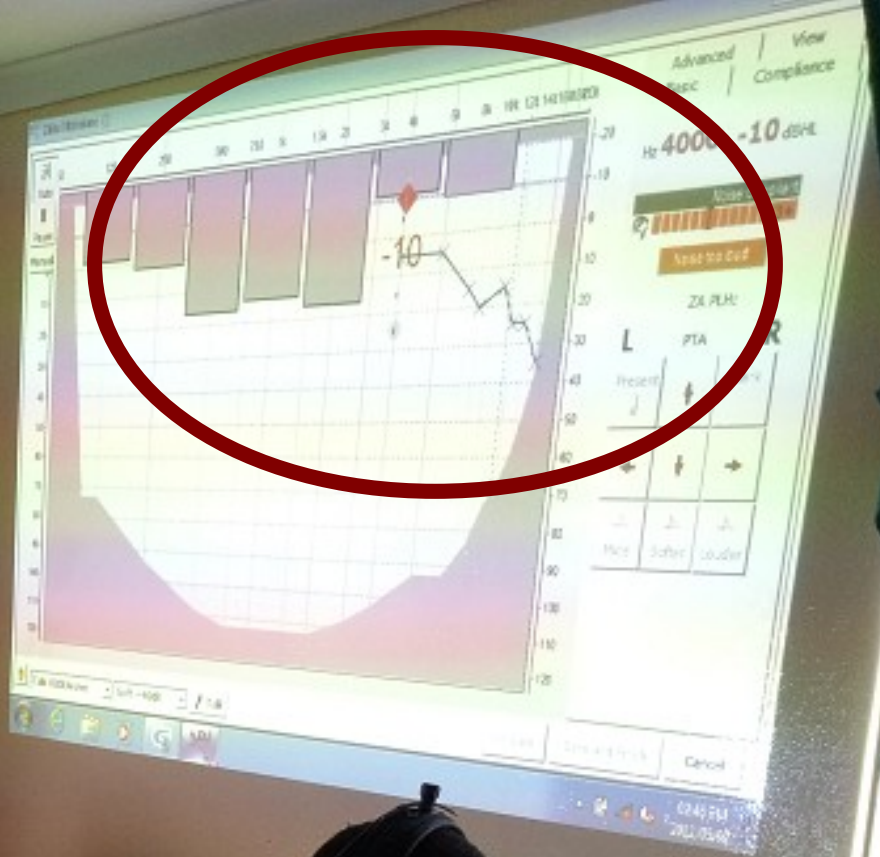
[Export all patient data](#)

[Delete this patient](#)

Personal Data | Clinical Data | **KUDUwave Pure Tone Audiometry**




Compliance	View	Notes
Test		
Hz	1000	30 dBHL
Quiet enough to present		
	Noise did not mask the tone	
L	R	LR
AC	BC	UCL
		MCL



Current user: Dirk Koekemoer, registered with the HPCSA

[Change user](#)

[Setup >>>](#)

 Patient list

- + MdrTbMm1.geoaxon
- + MdrTbMm2.geoaxon
- + MdrTbMm3.geoaxon
- + MdrTbMp1.geoaxon
- + MdrTbMp2.geoaxon
- + MdrTbMp3.geoaxon
- + MdrTbNw1.geoaxon
- + MdrTbNw2.geoaxon
- + MdrTbNw3.geoaxon
- + MdrTbNw4.geoaxon
- MdrTbStm.GeoAxon
 - + _Biological tests
 - + _Patients
 - _TeleMedicine
 - + Interpreted
 - + Temporary
 - + **To Interpret**
 - Resources
 - Software
- + MdrTbWc1.geoaxon
- + MdrTbWc2.geoaxon

eMOYOc\MdrTbStm.GeoAxon_TeleMedicine\To Interpret

Surname	Name	Date of Birth	Gender	Unique C
		12/30/1899	Male	DCD69E
		1/26/1981	Male	249DFF7
		2/28/2012	Male	CC3B3C
		2/28/2012	Male	71675E8
		5/25/1999	Female	2FDD0C
		2/28/2012	Male	F2F3256
		2/2/1982	Male	2D8B128
		12/25/1951	Male	637F9F0

Log In

Please enter your username and password. [Register](#) if you don't have an account.

Account Information

Username:

Password:

Keep me logged in

eMOYO Server

GeoAxon - We take healthcare to the people

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Welcome dirk! [[Log Out](#)]



Reporting



[PLH Report](#)



[Ototoxicity Report](#)



[Hearing Loss Report](#)



[Admin Report](#)

[Contact Us](#)



View/Interpret Test Results

Test Count: 69

[Back](#)

VTC

VC

Folder

MDR TB

St Margarets

_TeleMedicine\To Interpret

Showing results for: MDR TB

St Margarets

_TeleMedicine\To Interpret

1 [2](#) [3](#) [4](#) [5](#) ...

<input type="checkbox"/>	<u>VTC</u>	<u>Clinic</u>	<u>Test Date</u>	<u>Interpreted</u>	<u>Care Giver</u>	<u>Patient</u>
	MDR TB	St Margarets	2013/01/30 03:14:32 PM		Bonginkosi Sandile Ndlovu	
	MDR TB	St Margarets	2013/01/30 03:02:07 PM		Bonginkosi Sandile Ndlovu	
	MDR TB	St Margarets	2013/01/30 02:48:24 PM		Bonginkosi Sandile Ndlovu	
	MDR TB	St Margarets	2013/01/30 02:32:11 PM		Bonginkosi Sandile Ndlovu	
	MDR TB	St Margarets	2013/01/28 03:14:27 PM		Bonginkosi Sandile Ndlovu	
	MDR TB	St Margarets	2013/01/28 02:51:45 PM		Bonginkosi Sandile Ndlovu	

A black and white photograph of Nelson Mandela. He is shown from the chest up, looking out of a window with vertical bars. He is wearing a light-colored, long-sleeved button-down shirt. The lighting is dramatic, with strong shadows on his face and the wall behind him. The window shows a glimpse of an outdoor area with some foliage.

**The greatest single challenge facing
our globalized economy is to
combat and eradicate its disparities**

- Nelson Mandela - 1998

Secret to successful Tele-Audiology implementations to eradicate disparities

- You need a champion!
- You need to be bold and implement
- You need patience and a lot of perseverance
- You need brass balls to travel this road less traveled
- You need to ask for forgiveness if you stepped on toes
- Multiply your roll-out budget and time to roll out with π and be sure to have an excellent project manager





Thank you

**We can
take audiology services
to the peoples of South Africa**

**Dr Dirk Koekemoer
Chairman of GeoAxon Tele Health
dirk@geoaxon.com**