PRE-ALERT

Pre-hospital Rapid Evaluation via Ambulance Lead Emergency Remote Telemedicine

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Why not think inside the box?

- Efficacy and safety of stroke thrombolysis is *time dependent*
  - AHA/ASA developed *Target: Stroke* initiative to increase number of AIS patients treated within a 60 min DNT
  - Called for *innovative* approaches to prehospital stroke care

- Innovative approaches to enhance prehospital stroke care
  - Prenotification
  - Administration of neuroprotective agents in the field
  - Specialized ambulances

- Prehospital Mobile Telestroke
  - Improve accuracy of prehospital stroke diagnosis
  - Facilitate appropriate patient triage
  - Reduce stroke onset-to-treatment time
  - Assist in prehospital stroke research

	Type of methodology	Delivery	Wireless cellular communication	Telemedicine platform	Assessment	Results
LaMonte et al. 2000 **North America**	A pilot feasibility study	Store & forward	2G	Existing open system commercial components with parallel array of 4 digital cellular phones	Restructured NIHSS	31 testing sessions conducted 18 laboratory tests 7 ambulance tests 6 during patient transport Unstable transmission
LaMonte et al. 2004 **North America**	Validity & Reliability via Simulation study using the NINDS training videotape	Store & Forward	2G			Interrater reliability high Kappra values >0.5
	Evaluate time to treatment by comparing with historic controls					Compared with historic controls 17 minutes vs. 33 minutes
Liman et al. 2012 **Europe**	Concept and pilot feasibility simulation study	Mobile, real-time audio-video	3G	Prototype mobile telemedicine device (VIMED CAR)	NIHSS assessments	18/30 assessments could not be performed 12/30 interrater agreement moderate to good
Bergrath et al. 2012 **Europe**	Prospective pilot feasibility study	Real-time audio-video and still pictures	2G & 3G	Portable data transmission unit (peeg-box) with four parallel data channels from different network providers	14 item stroke history checklist	Partial dropouts of single applications 3/18 Neuro co-evaluations by teleEMS physician in 12 cases Video quality deemed good to excellent Compared to standard of care: No difference in time or diagnostic quality

	Type of methodology	Delivery	Wireless cellular communication	Telemedicine platform	Assessment	Results
Van Hooff et al. 2013 **Europe**	Pilot feasibility simulation study	Mobile, real-time audio-video	4G	Prototype mobile telemedicine device	Unassisted Telestroke Scale (UTSS)	40/41 assessments completed Excellent intra-rater and interrater agreement
Wu et al. 2014 **North America**	Pilot feasibility simulation study	Mobile, real-time audio-video	4G	Existing portable telemedicine unit – RP-Xpress system	NIHSS assessments	34/40 completed without major technical difficulty 30/34 matched the NIHSS by +2 points Intraclass correlation 0.997 Moderate to excellent interrater agreement
Eadie et al. 2014 **Europe**	Pilot feasibility simulation study	Mobile real-time audio-video	2G & 3G	Omni-Hub communications system	NIHSS,mRS, Recognition of stroke in the Emergency Room score, and exclusion criteria for thrombolysis	19 mobile and 4 stationary assessments completed High ratings when asked whether the AV system allowed adequate diagnosis
iTREAT **North America**	Pilot feasibility simulation study	Mobile, real-time audio-video	4G	Off the shelf, tablet-based telemedicine system	NIHSS assessments	27 completed without major technical difficulty Intra-class correlation UVA 0.98 UCSF 0.94 Combined 0.96
Itrat et al. 2016 **North America**	Prospective observational study	Mobile, real-time audio-video	4G LTE	Existing portable telemedicine unit – RP-Xpress system	Evaluation and treatment of prehospital mobile telemed vs control	99/100 encounters completed 93/100 conducted without any transmission disruptions Median log-in duration – 20 min

Study Setting

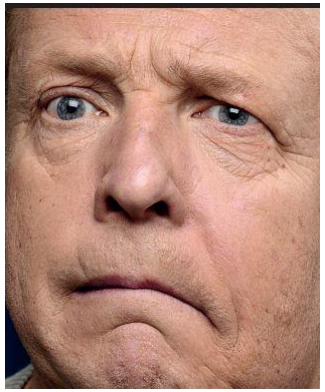
- Collaboration between the VCU Departments of Neurology and Emergency Medicine, VCU Comprehensive Stroke Center, VCU Office of Telemedicine and Richmond Ambulance Authority (RAA)
- Catchment area is the City of Richmond with transportation to VCU, a Level I Trauma Center
- The City of Richmond EMS system (RAA) serves a metro area of 222,000 with over 27,000 transports per year

Local Data for CY 2015		
VCU Health Hospital		
Number of ischemic stroke discharges	476	
Number of TIA discharges	45	
IV tPA given to patients in the ED	71	30 min median door to needle time
Patients transferred to VCU post IV-tPA	25	
Number of Mechanical thrombectomies	60	49 min - fastest door to groin time

Number of Suspected Stroke/TIA patients transported to VCU via RAA

Month	Impression	Sum
Oct-2014	CVA/TIA-PCR	21
Nov-2014	CVA/TIA-PCR	11
Dec-2014	CVA/TIA-PCR	14
Jan-2015	CVA/TIA-PCR	8
Feb-2015	CVA/TIA-PCR	13
Mar-2015	CVA/TIA-PCR	17
Apr-2015	CVA/TIA-PCR	4
May-2015	CVA/TIA-PCR	20
Jun-2015	CVA/TIA-PCR	12

Detection

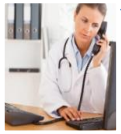


Prehospital Evaluation

EMS Provider

Perform CPHSS and document score

Location 1



On Call Investigator Vascular Neurologist (VN)

Evaluate patient with assistance of paramedic

Independent documentation of NIHSS

Location 2

Senior Stroke Neurology Resident

View neurological evaluation being conducted by VN

Independent documentation of NIHSS, potential diagnosis and treatment plan

Senior Stroke Neurology Resident & On Call Investigator Vascular Neurologist (VN)

Discuss via phone case and plan for treatment pending CT scan results.

Senior resident will document treatment plan as discussed with On Call **Investigato**r VN

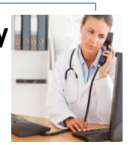
Bedside Hospital Evaluation

On arrival to hospital patient taken straight to CT Scan

Blinded junior stroke resident conduct a neurological examination

Independent documentation of NIHSS

Junior Stroke Neurology Resident & On Call Investigator Vascular Neurologist (VN)



Imaging reviewed with Neuro Radiologist

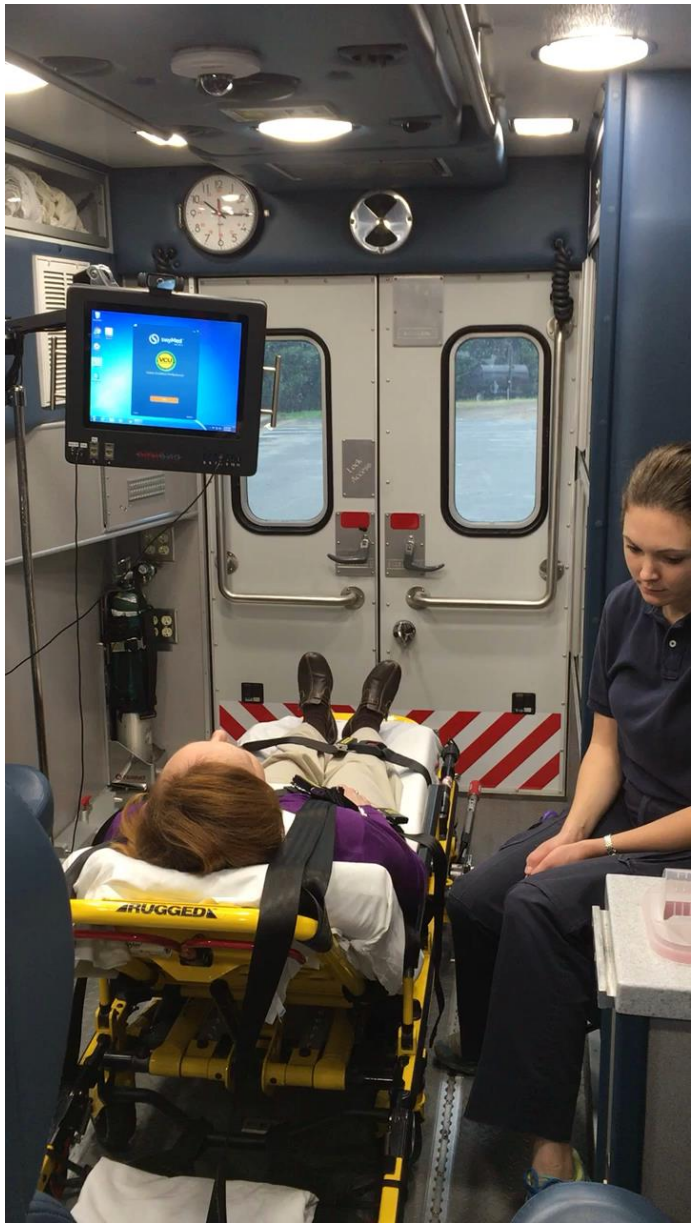
Junior resident discuss case with On Call **Blinded Attending** VN and treatment decision made

Treatment administered

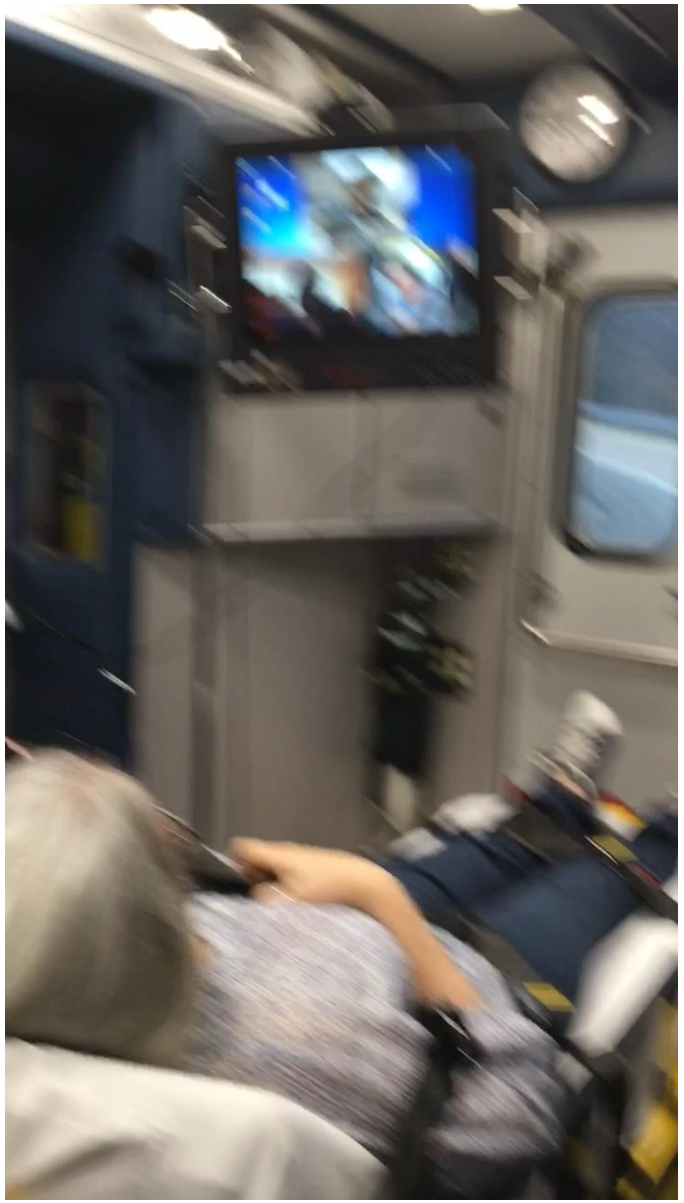
Junior resident & On Call Attending VN document potential diagnosis and treatment plan

Obtain additional imaging

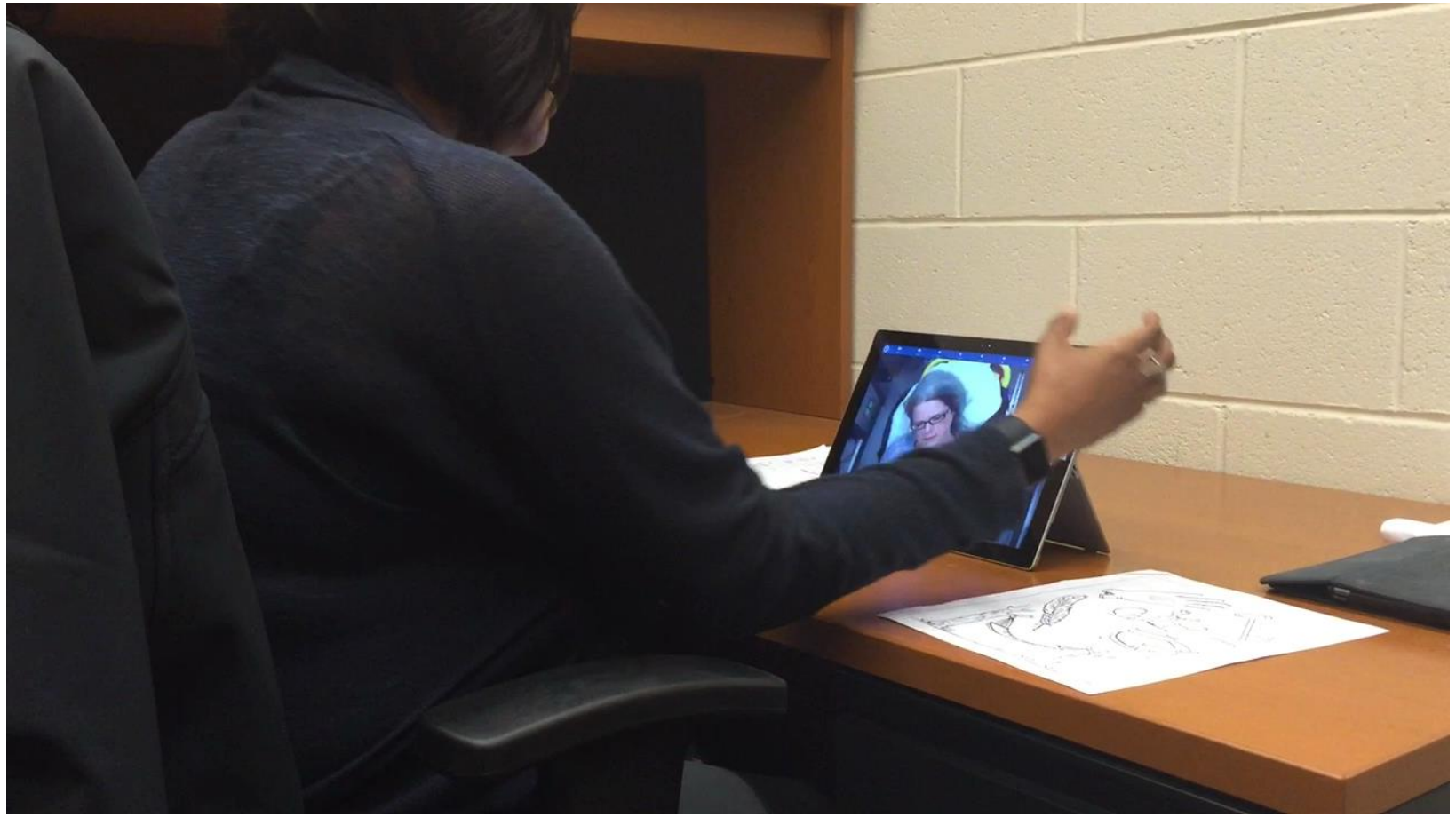
View of Ambulance



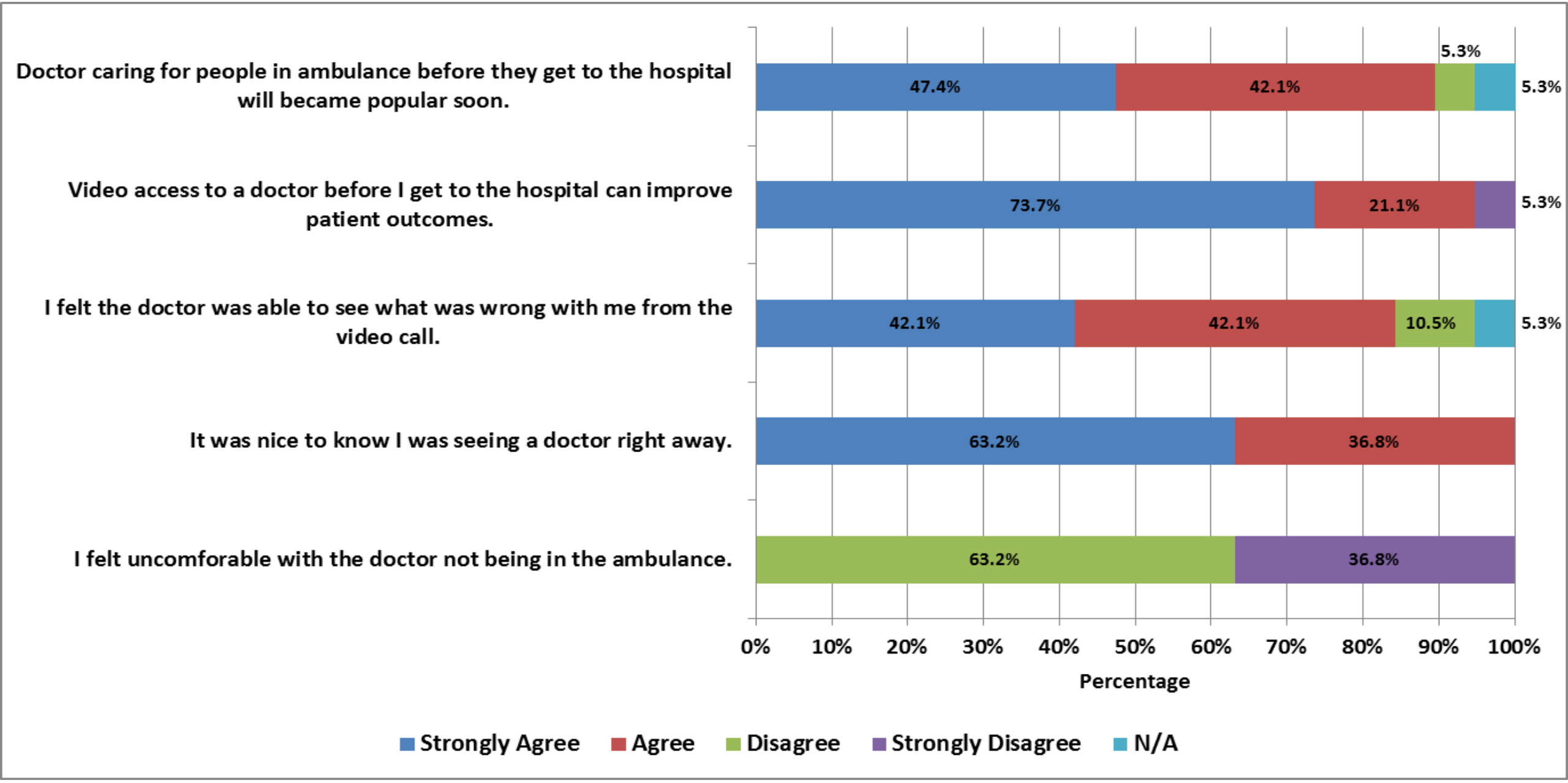
Ambulance Evaluation



Video Clip – Physician Evaluation



Standardized Patient Perceptions



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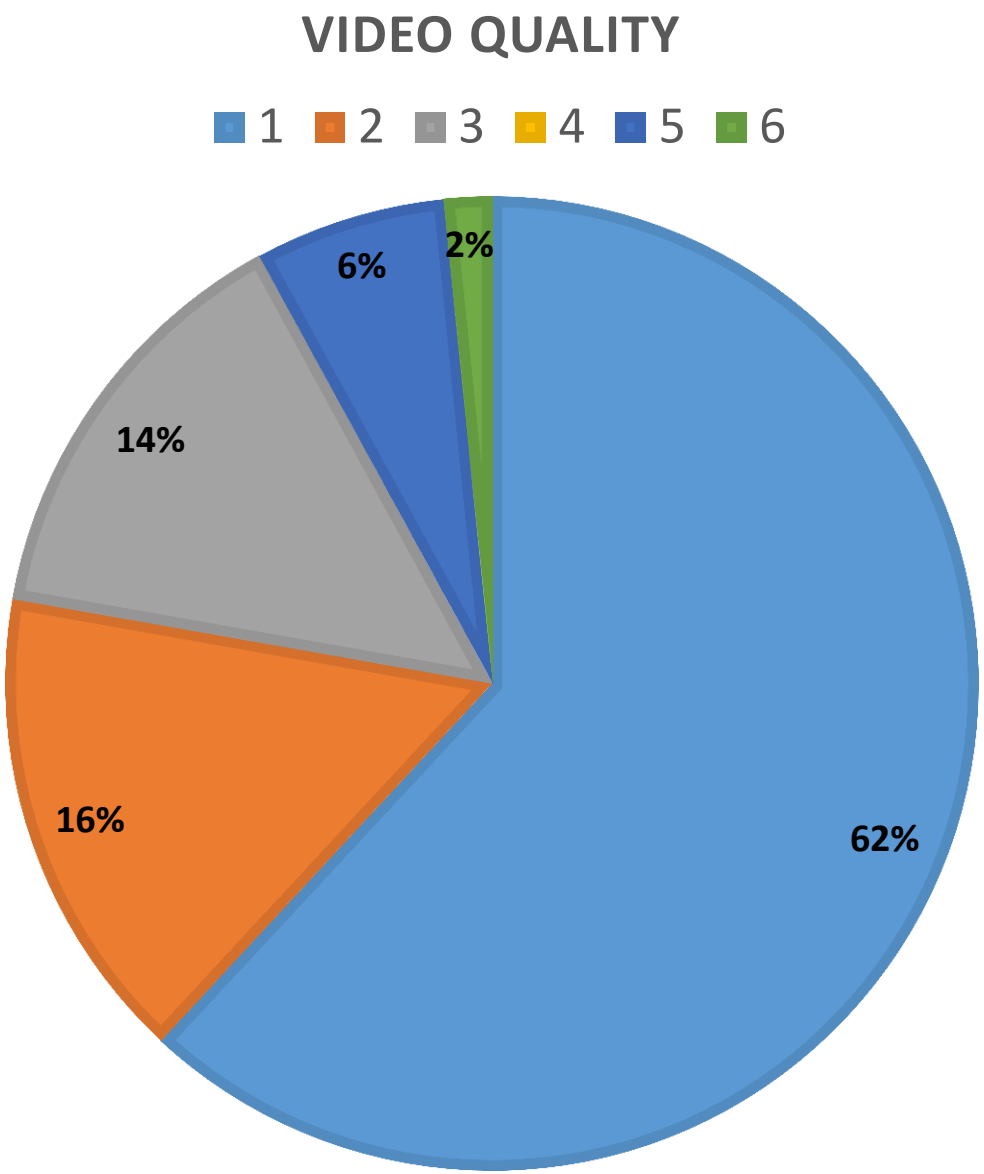
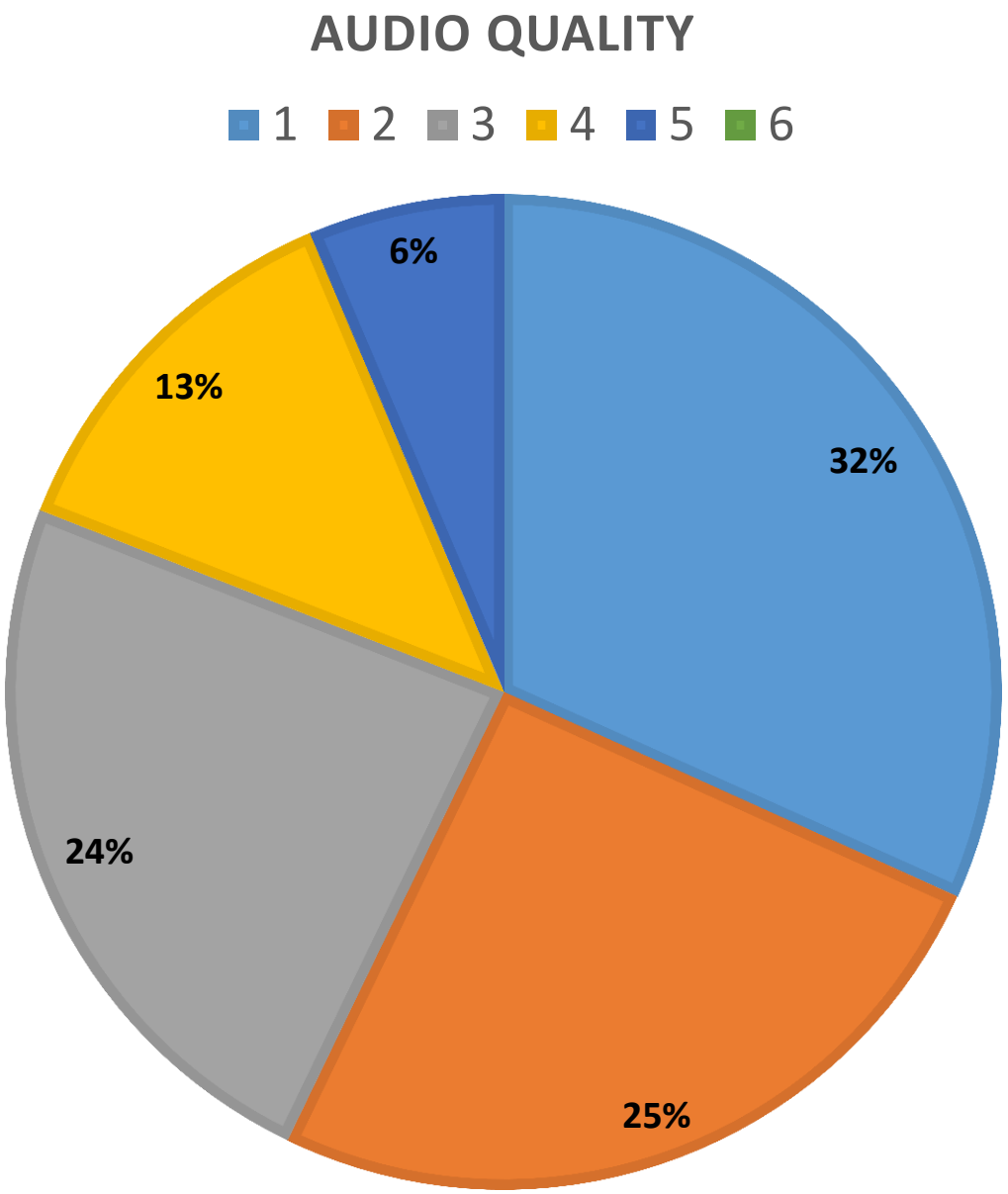
Additional Slides

Lessons Learned



Video Quality

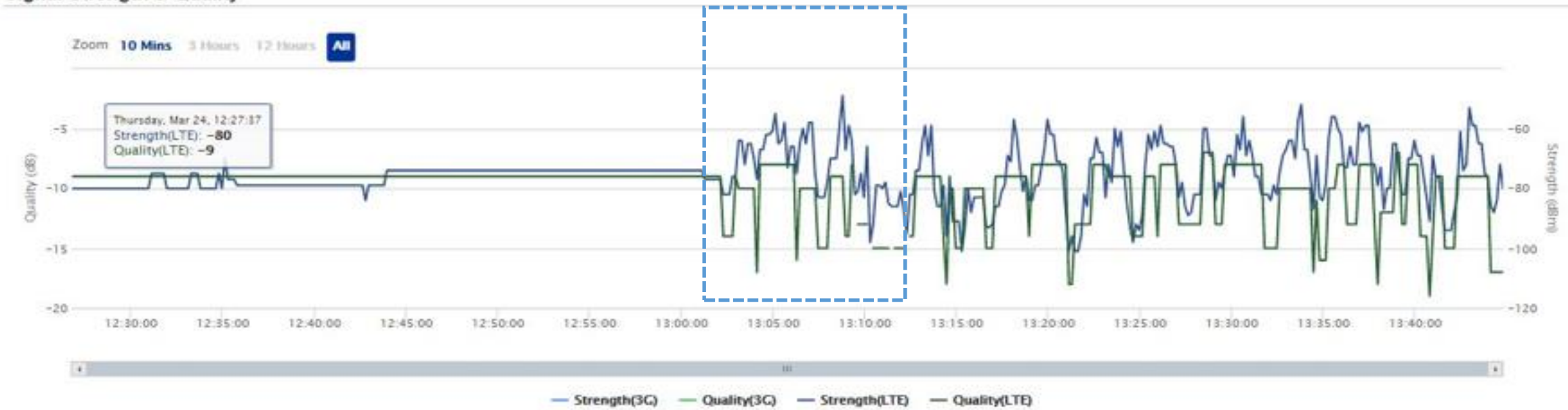
- 1 Continuously accessible signal
- 2 Predominantly accessible video signal
- 3 More accessible video signal than inaccessible
- 4 more inaccessible than accessible
- 5 Frequent loss of signal, predominantly inaccessible
- 6 No signal or continuously inaccessible



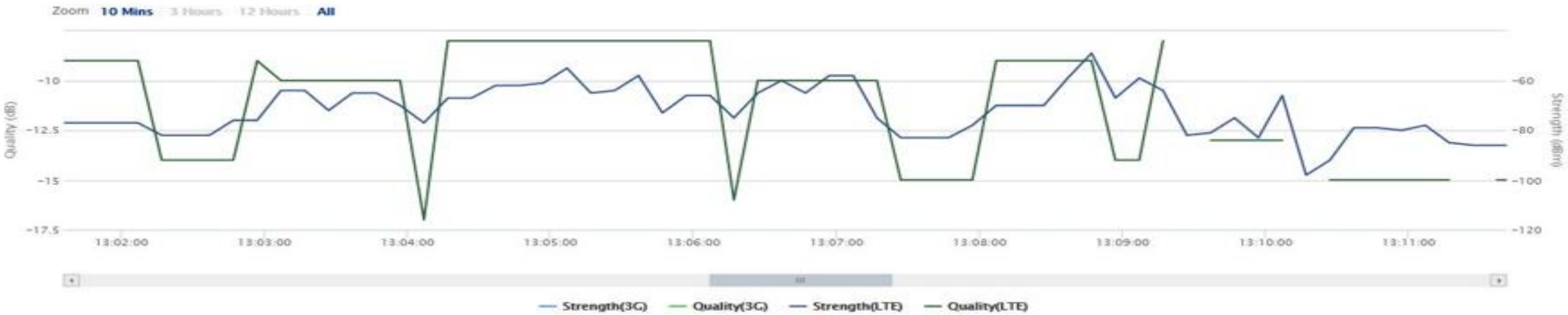
Audio Quality

- 1 Continuously accessible signal
- 2 Predominantly accessible video signal
- 3 More accessible video signal than inaccessible
- 4 more inaccessible than accessible
- 5 Frequent loss of signal, predominantly inaccessible
- 6 No signal or continuously inaccessible

Signal Strength & Quality



Signal Strength & Quality



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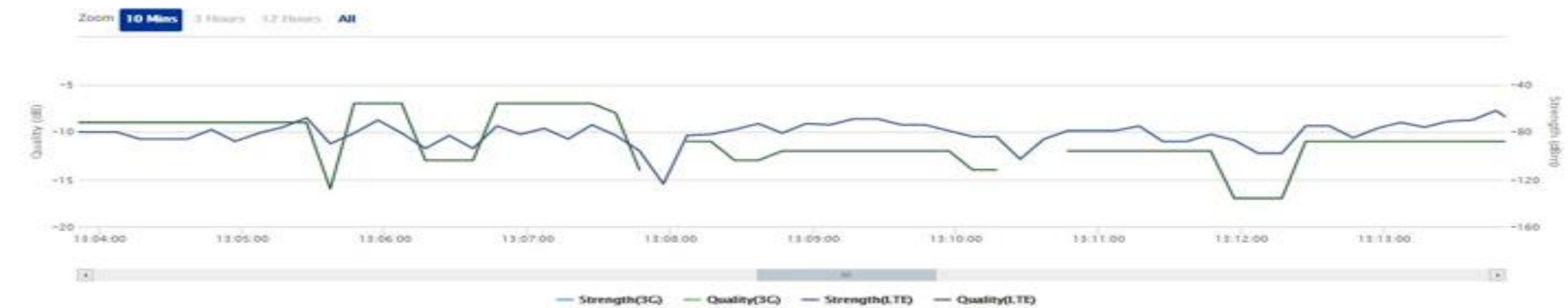

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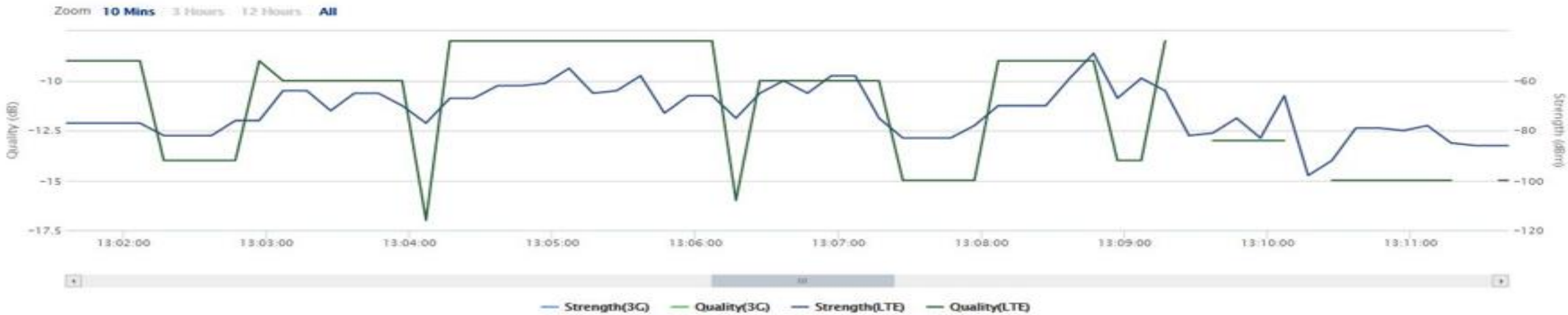

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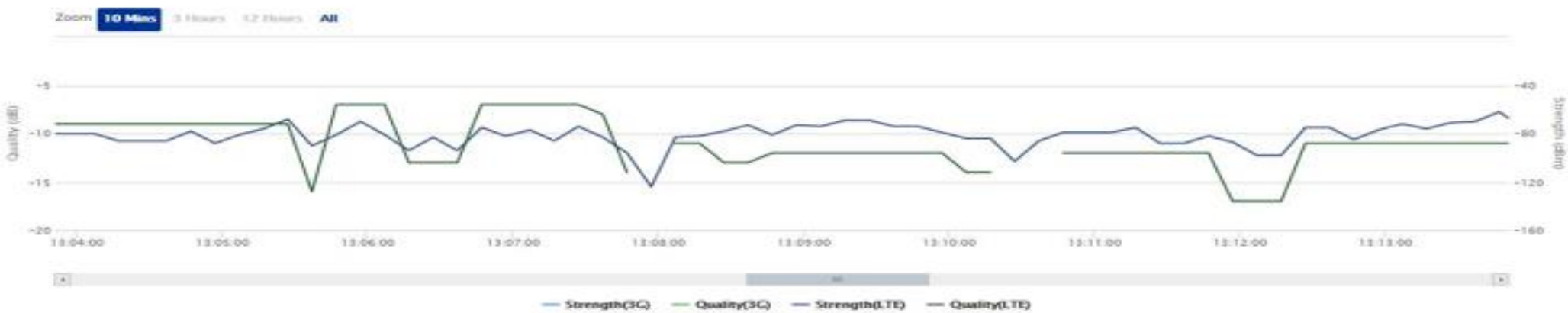

Conclusions & Future Directions

- Use of prehospital mobile telemedicine to evaluate patients en route to the hospital is feasible
- Development requires strong collaborations and usability testing
- Future Directions
  - Second simulation after implementation of changes
    - Repositioning of speaker-microphone
    - Wireless headsets for patient and EMS provider
    - USB headset for physician
    - Bonded AT&T-Verizon
  - Usability testing of portable mobile platform compared to ambulance installed
  - Prospective clinical efficacy study with stroke patients