Affordable prescription hearing aids
Billion people worldwide suffer from hearing loss

1.57

Current hearing aid suppliers meet less than 10% of the global need

<10%

$500+

Prescription hearing aids are unaffordable to the majority
### The Problem

**WHO suggest the RRP of an affordable hearing aid is 3% GDP/capita**

<table>
<thead>
<tr>
<th>OECD</th>
<th>Benchmark countries (OECD classification)</th>
<th>GDP/capita</th>
<th>3% GDP/capita</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High Income</strong></td>
<td>USA (H)</td>
<td>$63,500</td>
<td>$1905</td>
</tr>
<tr>
<td></td>
<td>Germany (H)</td>
<td>$45,700</td>
<td>$1371</td>
</tr>
<tr>
<td></td>
<td>UK (H)</td>
<td>$40,300</td>
<td>$1209</td>
</tr>
<tr>
<td><strong>Upper Middle-lower Middle</strong></td>
<td>Costa Rica (UM)</td>
<td>$12,070</td>
<td>$362</td>
</tr>
<tr>
<td></td>
<td><strong>World</strong></td>
<td>$10,900</td>
<td>$327</td>
</tr>
<tr>
<td></td>
<td>Argentina (UM)</td>
<td>$8,442</td>
<td>$253</td>
</tr>
<tr>
<td></td>
<td>Brazil (UM)</td>
<td>$6,800</td>
<td>$204</td>
</tr>
<tr>
<td></td>
<td>India *(LM)</td>
<td>$3,690</td>
<td>$111</td>
</tr>
<tr>
<td></td>
<td>Egypt (LM)</td>
<td>$3,550</td>
<td>$106</td>
</tr>
<tr>
<td><strong>Low Income</strong></td>
<td>Uganda (L)</td>
<td>$817</td>
<td>$25</td>
</tr>
<tr>
<td></td>
<td>Sudan (L)</td>
<td>$596</td>
<td>$18</td>
</tr>
<tr>
<td></td>
<td>Sierra Leone (L)</td>
<td>$485</td>
<td>$15</td>
</tr>
<tr>
<td></td>
<td>Somalia (L)</td>
<td>$105</td>
<td>$3</td>
</tr>
</tbody>
</table>

*OECD classification: (H) high income, (UM) upper middle, (LM) lower-middle, (L) low income
*based on initial target regions (Goa, Delhi, Haryana, Tamil Nadu, Telangana, Karnataka)
**alternative business models are possible based on different pricing structures.
Design specification

- Affordable in LM countries as per WHO criteria
- Dimensions similar to NHS BTE hearing aids (~ 30x15x8mm)
- Rechargeable Li-ion battery
- 20 hrs continuous operation
- Fully programmable/reconfigurable
- Dual microphones
- ‘full suite’ of hearing aid algorithms
- Bluetooth programmable via app (to reduced fitting hardware costs)
University Innovation (traditional)

University Research

Tech Transfer

Application Domain

Fundamental advance

App. 1

App. 2

⋯

App. N
University Innovation (alternative)

Problem - (affordable hearing aid)

- Engineering Design
- Manufacturing
- Clinical audiology
- Regulatory expertise
- Business planning
- Clinical trials

Application Domain

Human capital, expertise, resource
Engineering

- Embedded systems
- Electronic design
- PCB layout
- Firmware programming
- Software programming
- Signal processing
- Bluetooth
- Mechanical CAD design
- App design (Android)
- DFM, DFA
- Injection mould design

Manufacturing

- Rapid prototyping (3D printing)
- PCB fabrication
- PCB assembly
- Injection moulding

Clinical Audiology

- KEMAR testing
- Electroacoustic performance
- Prescription algorithms
- Patient fitting
- Patient testing (clinical trials)

Regulatory expertise

- ISO/IEC/ANSI etc standards
- Medical device certification

Business planning

- Market analysis
- Business plan
Digital hearing aid SoC
MCU based design

- MEMs digital Mics
- Multifunction momentary switch

Diagram:

- MCU
  - PDM
  - DSP
  - SPI
  - DAC
  - Android app

- POWER MANAGEMENT
- BLE
- USB BATTERY CHARGER

- POWER REGULATION
Real time block processing (development board)
Current consumption ~3mA,

Assembly issues: connectors are expensive and/or assembly difficult
Solution: Flex PCB?
mark 2 PCB: flex concept design

Flex would require 4-6 layer HDI board (expensive!)

Solution: MCU/RF module + 2 layer flex (min. vias .2mm)
mark 3: flex PCB  (only 4 flying leads)

MCU/RF    DAC    power    switch, LED    mics

Debug

117mm

Debug interface
charging contacts (nickle/gold plated steel)
HA Docking station

USB cable (proprietary connector)

Magnetic contacts
Gen 1 product

- Battery: >20 hours per charge
- Full suite of algorithms
- Bill of Materials < £35 (1000 units)
- Size: 33x15x8mm
- Programmable by app
Journey so far...

2018
Proof of concept

2019
Prototype development

2022
1st prototype
Clinical Trials (Nepal)

2023 - 2024
Seed Funding
£300k
Commercial Prototype
Gen 1 sales commence
We are here

2024
50k units
£3.2m
Europe, USA: mature market

SAARC developing markets
3 x larger than the mature market

• US+EU combined population of 900m
• 46m (4.6%) suffer from significant impairment
• Sales >$5bn per annum
• >10m devices per annum

• Southern Asia population >2bn
• 127m (7.4%) suffer from significant impairment
• SAARC is the largest global market
• Only 2% can afford prescription hearing aids
Thank You

Nigel Stocks
University of Warwick
N.G.Stocks@warwick.ac.uk
+44 (0) 7972 804779