EVOTION: Big data supporting public hearing health policies

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Introduction

EVOTION is a three-year cross-disciplinary project funded by the European Union were partners with clinical, technical, and public policy making background investigate big data supporting public hearing health policies.

EVOTION has developed a platform with components that collect usage data from their hearing aids via a smartphone, components that collect medical health records related to hearing from the clinical databases, big data analytics engine to analyze the collected data, and a new public health policy specification language for modeling of public hearing health policies. The EVOTION components employ encryption and pseudo-identifiers to preserve privacy and security.

Using the internet connection of the EVOTION mobile, the EVOTION hearing aids transmits estimators of the sound environment, and 4 bands of sound pressure level, envelope modulation parameters, and signal-to-noise ratio, to the EVOTION Data Repository one time every minute. By design, the single vector pr. minute is a non-evasive collection of sound data that preserves the privacy of communication around the hearing aids.

EVOTION has started the collection of real time usage data from more than 1000 patients' hearing aids in United Kingdom, Greece, and Denmark. Together with associated medical hearing health records the combined data allows analysis that targets individual preferences for hearing aid settings, benefits of auditory training and prevention of noise induced hearing loss in clinical settings, and prognosis of benefits from hearing aid usage to support public hearing health policies.

Future use of health data for policies

Future health care connects data from end-users, HCPs, and policy makers to monitor, revise, and formulate new health policies.

At end of project, the EVOTION platform will demonstrate how public health policy makers work with policies ranging from analyzing data from many end-users, comparing to literature, and implementing policies.
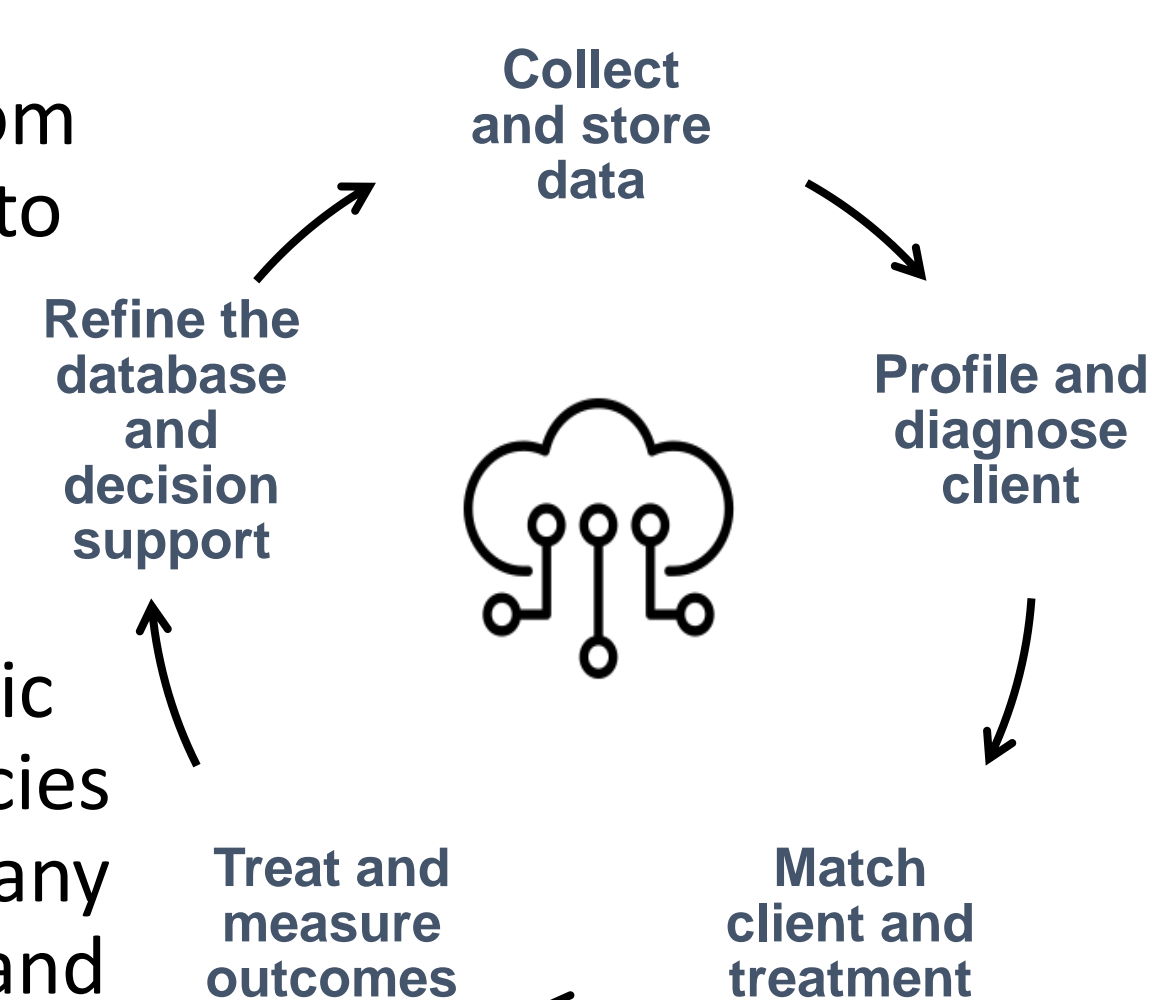
EVOTION Platform
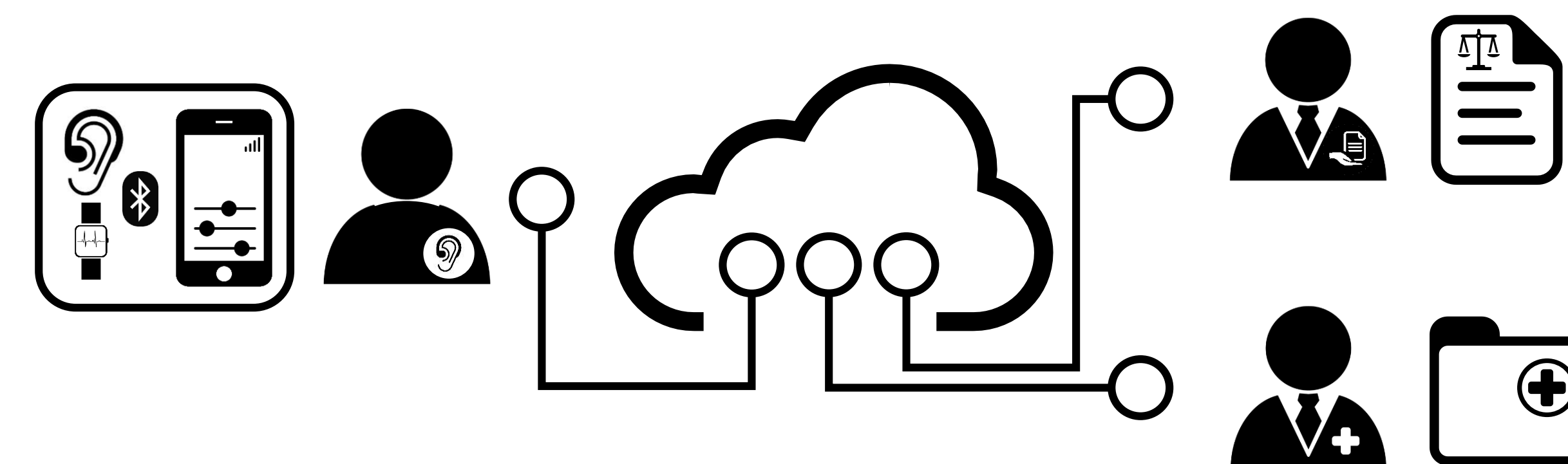
The EVOTION platform connects three stakeholder groups: end-users/patients, clinicians/HCPs, and policy makers. EVOTION platform employs separate interfaces for all three groups.

End-users interact with the platform using the EVOTION app installed on the EVOTION phone or their EVOTION hearing aids. Data is only logged when phone and hearing aids are connected over Bluetooth Low Energy without further buffering in hearing aids. End-users change programs and volume with hearing aid buttons or phone.

HCPs and policy makers interact with the platform using custom web-interfaces – so far developed for HCP's and clinical data.

EVOTION has developed a formal specification and language that defines the way the public health actor interface will operate and the functionality.

Interventions

The EVOTION platform enables 3 interventions:
1) Self-management of hearing aid settings between 4 programs with different levels of OpenSound Navigator noise reduction settings.
2) Monitoring of hazardous noise levels and alerts
3) Auditory training and hearing tests.
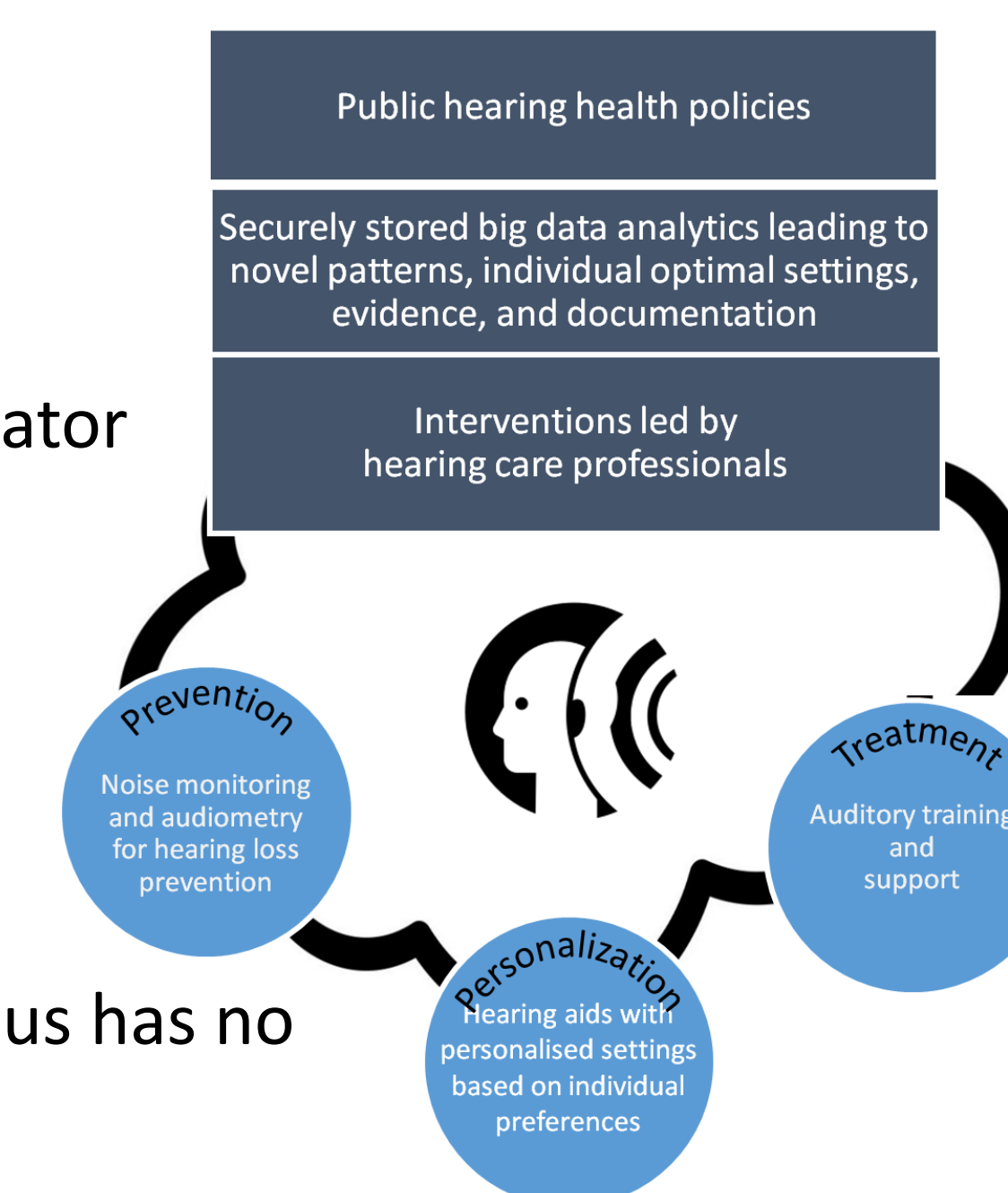
EVOTION is not a clinical trial and thus has no control group.

Data

Generic Data Type	Specific Data Type	Means of capture			
		HA	Sensor	Mobile	Clinic
HA logging	Periods of HA usage	X			
	Use and adjustment of HA controls	X			
TTS episode related	Predicted TTS values due to noise exposure and time required for recovery	X		X	
	Time of occurrence and severity of actual TTS episodes	X	X	X	
	Self-administered PTA at 4kHz			X	
Audiological	PTA in quiet				X
	Speech in Noise			X	
	Reaction time (in Speech in Noise and Digit span tests)	X		X	
	Satisfaction with HA usage			X	X
Physiological	Heart rate		X		
Cognitive	Cognitive assessment				X
	Digit recall test for auditory working memory			X	
Mood and quality of life	Mood and anxiety monitoring				X
	Quality of life				X
Clinical and medication	Diabetes				X
	Obesity				X
	Family history of HL				X
	History of medications				X
	Duration of HL				X
	Cause of HL				X
Behavioural and lifestyle	Watching television	X		X	
	Participating in conversations and meetings	X	X		
	Rating of HA ease or difficulty to use			X	
	Socioeconomic status				X
Personal	Education level				X
	Presence of significant others				X
	Age				X
	Gender				X
	Personal carer				X
Occupational	Employment history and current status (including noise exposure)				X
Environmental	Location		X	X	
	Noise type, frequency spectrum and level	X			
	Outdoor activities (e.g. conversations)	X	X		

Preliminary data analysis

HA usage
Density

HA usage
Count (%)
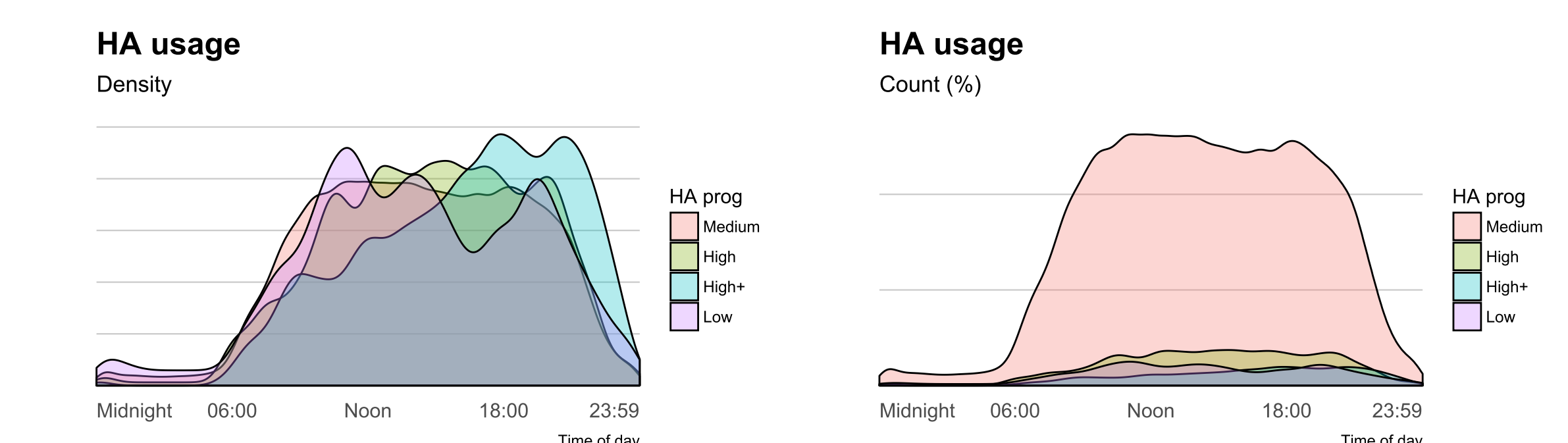
Usage patterns from a limited number of end-users over up to 2 months reveals preference for the default program (medium). The end-users are well aware of the 4 programs and instructed to use them. Moreover, the preliminary data indicate that the usage patterns are modulated by the time of day, where the highest level of help is chosen in the evening. However, this is co-existing with a usage pattern where the least help is also used more in the evening.

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EVOTION
BIG DATA SUPPORTING PUBLIC HEARING HEALTH POLICIES