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Commentary

Challenges and Strengths of Multidisciplinary Research in Audiology: The EVOTION Example

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Purpose: The EU-funded research project EVOTION has brought together clinical, technical, and public health experts with the aim to offer a solution for the holistic management of hearing loss. This report presents the challenges, strengths, and key take-home messages of working in this multidisciplinary consortium.
Method: Fifteen consortium members completed an online survey with 6 open-ended questions. Responses were analyzed using a thematic approach.
Results: Analysis identified 4 main themes: (a) *communication*, that is, cross-disciplinary communication difficulties but also range of expertise; (b) *opportunities*, that is, innovation, learning, and collaborations; (c) *technology*, that is, technical requirements and data collection and management issues; and (d) *local constraints*, that is, institutional limitations, resources, and planning.
Conclusions: Although the challenges reported differed by country and specialty, there was consensus about the value, expertise, and opportunities of the project. It is recommended that in future similar multidisciplinary projects in audiology, researchers establish a common language and assess technical requirements and local constraints prior to initiating research activities.

A multidisciplinary approach is required to address many of the 21st century's complex scientific challenges. In the field of audiology and hearing research, studies have traditionally been of a small scale (small number of sites and subjects) and have focused on assessing specific outcomes of interventions. However, because there is now the possibility of collecting large-scale, real-time data from multiple sources, the challenges associated with multidisciplinary collaborations are coming to the forefront. Specifically, there is a need for collaboration involving information technology (IT) departments, data scientists, as well as clinicians, and to apply methods beyond those of traditional clinical research and practice.

There is strong evidence that hearing aids (HAs), the primary treatment for hearing impairment, can improve communication and quality of life for many users (e.g., Ferguson et al., 2017). However, some individuals are dissatisfied with their HAs and use them to a limited extent (Abrams & Kihm, 2015; European Hearing Aid Manufacturers Association, 2018). This has huge cost implications for National Health Systems. Furthermore, there is considerable variability in performance outcomes (Lopez-Poveda et al., 2017), making it difficult to use small data sets for the development of health care policies. Interdisciplinary, holistic approaches to the management of hearing loss (HL) can yield needed insights into HA uptake, use, and outcomes, so that changes can be made at the population and public health policy-making level (Reavis, Tremblay, & Saunders, 2016).

As scientists and policy makers alike push for use of interdisciplinary data collection and analysis, it seems appropriate that we share our experiences from a large EU-funded

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research project in which we brought together a wide range of clinical, technical, and public health experts (see Table 1). This way, others can apply what we have learned to move the field forward.

The EVOTION project aims to build the evidence base for the formulation of public health policies related to the prevention, diagnosis, and rehabilitation of HL (Gutenberg et al., 2018). The project is developing a decision-making platform including components that enable (a) static and real-time data from HA users to be fed into a data repository and (b) the application of big data analytic techniques (Katrakazas, Trenkova, Milas, Brdarić, & Koutsouris, 2017). In parallel, a multicenter clinical study with > 1,000 HA users is currently collecting big data (including data via smart HAs and a mobile application) for the validation of the platform (Dritsakis et al., 2018). In the remaining 3 months of the project, the evaluation of the platform from a clinical, technical, and public health policy-making perspective will be completed.

The novelty and complexity of the work, and the size and diversity of the consortium, have posed several organizational, technical, and scientific challenges, but have also revealed the many strengths of the consortium. We believe that our experience from this project can help other researchers conduct multidisciplinary projects in the future. This holds for studies initiated by those in the field of audiology as well as for studies of other disciplines in which audiological scientists are invited to participate. We propose that, with increased awareness about the wide-ranging impacts of HL on cognition, social activity, and quality of life overall (e.g., Davis et al., 2016), such collaborations should, and will, increase over time. The aim of this article is to share the key barriers and facilitators encountered at an organizational and logistical level during the EVOTION project to date as learned from a survey of partners.

Method

Forty-seven EVOTION consortium members were invited to complete an online questionnaire (developed by the first and last author) with six open-ended questions related to their experience during the project (see Table 2). Fifteen individuals responded (see Table 3 for the respondent characteristics).

Responses were analyzed thematically using NVivo (Version 12.2) software and broadly following the recommendations by Braun and Clarke (2006). Statements relevant to the aims of the survey were initially coded under the broad domains "challenges," "strengths," "lessons," "additional work," "unexpected events," and "messages" as per the survey questions. However, there was an inevitable thematic overlap in the responses provided with certain concepts common between these domains. For example, "communication" and "knowledge" were mentioned both as challenges (i.e., need for a common language, IT knowledge requirements) and as strengths (i.e., range of views, learning opportunities). Therefore, a different coding approach was followed to identify common patterns that cut across the above initial domains. Specifically, we looked at the concepts that were mentioned most and by most different participants regardless of whether they were brought up as an advantage, difficulty, learning point, and so forth. Then, within each of these broad themes, we explained the different ways they have been key to the project so far with specific examples.

Results

The key themes and sub-themes that were identified in the responses can be found in Figure 1. They are also presented below in detail along with the number of respondents commenting within each key theme and the number of references (i.e., times the theme was referred to by participants). In addition, illustrative quotes are provided for each theme.

Theme 1: Communication (14 Respondents, 45 References)

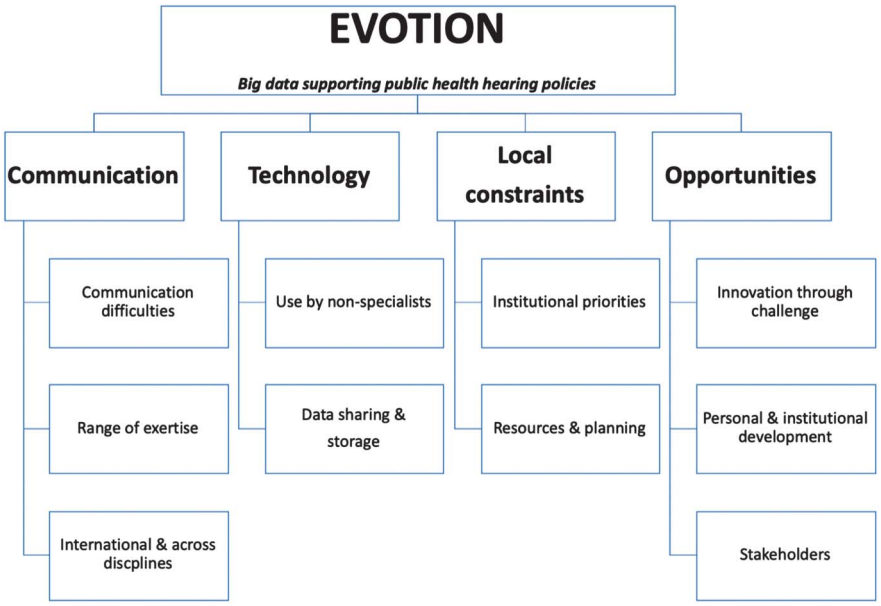
Communication was one of the most common themes and was raised by all but one respondent. Communication difficulties among colleagues from different disciplines

Table 1. Full list of the clinical, technical, and public health EVOTION partners.

Technical partners	Clinical partners	Public health partners
Oticon A/S (Denmark)	University College London (United Kingdom)	Institute of Public Health for the Osijek-Baranja County (Croatia)
City University (United Kingdom)	Guy's and St. Thomas' NHS Foundation Trust (United Kingdom)	Pazardzhik Regional Administration (Bulgaria)
National Technical University of Athens (Greece)	University of Athens Hospital (Greece)	Nofer Institute of Occupational Medicine (Poland)
University of Milan (Italy)	Athens Medical Centre (Greece)	
Athens Technology Centre (Greece)		
Empelor GmbH (Switzerland)		

Note. Clinical experts include otolaryngologists, audiologists, or clinical researchers; technical partners include engineers and computer and data scientists; and public health partners include members of governmental and regional public authorities. In total, the consortium consists of 13 partners from seven European countries and is coordinated by Oticon A/S. The project runs between 2016 and 2020.

Figure 1. Main themes identified in the survey responses illustrating key challenges and strengths of the EVOTION project so far.



were highlighted as being one of the main challenges of the project. For instance, there was confusion between audiologists and public health professionals with regard to the clinical input in the development of the public health policy decision-making models and between audiologists and data/computer scientists with regard to the specifications of the clinical outcomes measures used in the project.

> "We [clinicians] use different terminology with technical partners, one word can have different meaning for clinicians/tech/public health colleagues." (Respondent 5, UK)

> "Individuals from different academic disciplines can easily make assumptions that those from other backgrounds will understand concepts which they use every day and are familiar with." (Respondent 13, UK)

> "A major challenge for me was to cooperate with the non-technical partners of the project." (Respondent 12, UK)

At the same time, the range of expertise and the different perspectives of consortium members were also identified as being one of the key strengths of the project despite the communication difficulties. Successfully merging these differences was seen as an achievement.

> "The fact that we were given the chance to see different point of views aimed to address issues with a solution that can be applied no matter where an individual resides is also one key positive aspect of the project." (Respondent 14, Greece)

> "[One of the strengths of the project was] to have fostered the cooperation among such different partners." (Respondent 6, Italy)

Theme 2: Opportunities (12 Respondents, 54 References)

EVOTION consortium members from all specialties and countries appreciated the novelty and value of the research. There was a sense that working across

Table 2. The six open-ended questions that EVOTION consortium members responded to.

No	Question
1	What were the challenges that you were faced with when working within this project/consortium?
2	What were the strengths/positive aspects of this project/consortium?
3	What did you learn that you wish that you knew at the beginning of the project? What new skills did you acquire?
4	Was there any additional work developed within your field by you or your team as a result of working within this project? How did this work benefit the field?
5	What did you encounter that was unexpected when working with this project/consortium?
6	What 3 key messages would you give to someone else planning a similar project?

Table 3. Demographics of the 15 EVOTION consortium members who responded to the survey.

Respondent	Specialty	Country	Years in the profession
1	Clinical researcher	United Kingdom	6–10
2	Research audiologist	United Kingdom	6–10
3	Public health specialist	Croatia	11–20
4	Researcher (auditory rehabilitation)	Denmark	> 20
5	Audio-vestibular consultant	United Kingdom	> 20
6	Computer scientist	Italy	> 20
7	ENT	Greece	6–10
8	Research audiologist	United Kingdom	0–5
9	Computer scientist	Italy	11–20
10	Public policy expert	Bulgaria	11–20
11	eHealth researcher	United Kingdom	6–10
12	Biomedical engineer	United Kingdom	6–10
13	ENT	United Kingdom	> 20
14	Biomedical engineer	Greece	0–5
15	ENT	Greece	6–10

Note. ENT = ear, nose, and throat. Of the respondents, 53% were clinical partners and 47% were based in the United Kingdom. There was a mixed amount of experience.

disciplines could stimulate other innovation activities, both within and beyond local institutions.

> "This project will create a novel prototype tool that will equip policy makers with evidence for their policy making decisions. There is no such tool worldwide to date."(Respondent 12, United Kingdom)

> "[A strength of the project was] using novel technologies in improving of public health; setting up new initiatives for changing hearing loss legislation." (Respondent 3, Croatia)

> "[A strength of the project was] the potential to harness technological developments for patient benefit." (Respondent 5, United Kingdom)

Respondents also noted that the project created opportunities for engagement and improved collaboration with stakeholders across countries and institutions.

> "The patients I work with were hugely supportive. They understood that engagement with big data and with public health were important for advancing their care."(Respondent 13, United Kingdom)

> "[It was positive to be] improving collaboration with public health stakeholders at local level; [and to have] established collaboration with new stakeholders such as NGOs and regional authorities." (Respondent 3, Croatia)

In addition to further advances and collaborations in the field, respondents emphasized the learning opportunities they had.

> "In an institution like the NHS which has historically struggled with managing large IT based projects, the influence of outside partners from commercial, public health and technology backgrounds can teach us how a such project can be technically feasible." (Respondent 13, United Kingdom)

Theme 3: Technology (12 Respondents, 24 References)

Technological issues were a major theme raised by respondents. Specifically, clinical and public health professionals from nontechnical backgrounds commented on the many technical requirements of the project, technical problems they encountered, and on difficulties with data access and management. Conversely, technical partners cited human factors as a major challenge.

> "[The novelty of the project] required me and my colleagues to grasp and understand highly technical tasks in order to provide our input from a policy-making point of view." (Respondent 10, Bulgaria)

> "[I wish] I had understood the complexities of accessing the data and that we could have designed it so data were more easily accessible." (Respondent 4, Denmark)

> "Difficulties in data gathering (including mobile device selection, sensors etc.) introduced a huge delay in getting into the real challenges of the project." (Respondent 9, Italy)

> "On one hand, personal data have to be protected. On the other hand, too complicated and time consuming [data collection and sharing] procedures set barriers to scientific knowledge. These are big issues to be resolved in a European level." (Respondent 15, Greece)

Many technical issues were related to constraints at local institutions, especially in large public sector organizations such as National Health Service hospitals, United Kingdom.

> "[One of the challenges was] the difficulty in setting up any system out of the ordinary in an NHS environment." (Respondent 8, United Kingdom)

> "[We encountered] the technical complexity of incorporating the project apps and solutions within the

NHS clinical assessment pathway." (Respondent 5, United Kingdom)

Theme 4: Local Constraints (8 Respondents, 32 References)

Other limitations of local institutions that were not technology related were also reported by respondents from multiple countries:

"[One of the challenges was] working within the NHS audiology patient pathways […] Think carefully about demands on clinicians' time and skills and prepare accordingly." (Respondent 2, United Kingdom)

"[An unexpected event was the] lack of knowledge of stakeholders and local community in HL problems." (Respondent 3, Croatia)

Finally, role allocation and task coordination were presented as other key challenges:

"[We had] difficulty understanding who does what because of [the] size of [the] consortium and complexity of tasks." (Respondent 1, United Kingdom)

"[Among the challenges were] coordinating activities across groups; realising that each group has different priorities and goals for the project that did not necessarily mesh with mine." (Respondent 4, Denmark)

Discussion

Patients, health care professionals, and the field of audiology, as a whole, can benefit greatly from the use of novel technologies such as smart HAs, mobile applications that allow self-testing and rehabilitation activities, the collection of real-time HA usage data, the collection and storage of HA data in a data repository, data collected from biosensors, and so forth (Spanoudakis et al., 2017). However, their optimal use and implementation require considerable interdisciplinary expertise and strong collaborations. Furthermore, positive collaborations and interactions between engineers, computer and data scientists, professionals from public health authorities, and policymakers can help audiologists, physicians, and ear, nose, and throat consultants think from different perspectives and understand the terminology of other disciplines. As learned here, interdisciplinary communication was both a barrier and a facilitator, emphasizing the importance of establishing a common language between audiologists and their collaborators prior to the initiation of any multidisciplinary project. The fact that the respondents considered the project to have generated opportunities for engagement with stakeholders across countries and institutions is noteworthy because engaging with the patients is particularly important for person-centered, individualized care that will achieve the maximum patient benefit.

A major reported barrier was associated with use of technology. From the perspective of clinical partners, technical requirements were high, complex, and limited by the systems in which they worked, whereas from the perspective of the technical partners, user design became an issue. The major learning from this is that innovative multidisciplinary audiological research requires clinical staff to be trained in new technologies and that data collection methods must be adapted to individual hospital IT systems and regulations, once again emphasizing the need for upfront discussion and planning. However, on a positive note, all partners felt strongly that the project was innovative, important, and inspiring, and they appreciated the range of expertise and the opportunities for learning and collaborations.

Based on our EVOTION experience, the key messages we would like to offer to other researchers trying technologically complex, multidisciplinary projects within the audiology domain are as follows:

- Establish a common language among disciplines and partners prior to/at the beginning of the project.
- Encourage and facilitate face-to-face discussions so partners can raise concerns and correct misunderstandings early on.
- Determine technical needs and evaluate technical knowledge up front and then educate all partners accordingly to ensure they have the necessary skills for conducting the work. For audiologists, this may include training on the use of new software and hardware, as well as staying up to date with data protection regulations (e.g., General Data Protection Regulation [GDPR]).
- Identify data needs and clarify data formats prior to starting the project. Data collection and management within NHS audiology centers, United Kingdom, the respective clinic management software (e.g., AuditBase, Practice Navigator) and exact version, as well as limitations with regard to extracting and transferring clinical data out of the hospitals and have to be considered.
- Have technically skilled members available to solve technological, data collection, and data management issues on an ongoing basis. This may include cooperation between hospital IT departments, project technical partners, and software/hardware manufacturers.
- Plan and set realistic expectations according to local resources and constraints prior to starting the project. This may require input, among others, from audiology managers, audiologists, ENT consultants, as well as IT and finance teams of the hospitals.

Summary and Conclusion

In summary, the main challenges of the EVOTION project were interdisciplinary communication, limitations at local institutions, and technical requirements. The pattern of views differed by country and mainly by specialty. For instance, audiologists and ENT specialists within the

NHS, United Kingdom, were concerned about resources and limitations imposed by their local audiology departments (staff, costs, time, local protocols); technical partners across countries faced difficulties communicating with nontechnical ones, and public health partners felt that the IT requirements of the project were excessively high.

Within the field of audiology, in particular, we believe that this work opens avenues for future data-related, technologically complex, and public health–focused work in audiology centers. In NHS audiology departments in the United Kingdom and elsewhere, such projects are feasible and can benefit patients with hearing impairment, audiologists, and the field overall, provided that stakeholders are willing to adapt to methods beyond traditional audiology practice.

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