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Creating Audio-Visual Content for a Personalized Prevention Programme in Coronary Heart Disease

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Abstract—**Coronary heart disease (CHD) remains the leading cause of premature death worldwide. Better risk stratification tools and personalized care of patients are needed for reducing the morbidity and mortality of CHD and the associated economic burden. However, contemporary e-learning solutions lack personalization and shared decision making and as a result, overwhelm patients with large amounts of information. CoroPrevention is a multiyear, EU-funded Horizon 2020 research project aiming to shape and implement a personalized secondary prevention strategy for patients with established CHD. As a part of the project, new digital tools will also be validated. In this paper, we discuss the process of creating audio-visual content for the CoroPrevention mobile application during the challenging COVID-19 pandemic.**

Keywords—CoroPrevention, cardiovascular disease, personalized prevention programme, video, animation, project management, education, e-learning

I. INTRODUCTION

Cardiovascular Disease (CVD) is the most common cause of death in Europe, with atherosclerotic diseases - especially coronary heart disease (CHD) - taking the lead. In Europe, about 55% of all female deaths are caused by cardiovascular disease (CVD), especially CHD and stroke, compared with 44% of all male deaths [1]. The risk factors of CHD include, e.g., smoking, high cholesterol, obesity, hypertension, diabetes, stress, and lack of exercise [2].

Prevention of CHD morbidity and mortality is a major challenge. CVD costs the EU economy almost €210 billion a year, and this is projected to rise with both the ageing population and the cost of novel treatments [3]. Thus, better risk stratification tools and personalized care of patients are needed for reducing morbidity and mortality of CHD and the associated economic burden [4].

"CoroPrevention: Personalized Prevention for Coronary Heart Disease" is an EU-funded Horizon 2020 research project aiming to develop and implement a personalized secondary prevention strategy for patients with established CHD. The digital platform ("CoroPrevention Tool Suite") supporting the CoroPrevention care pathway consists of three applications: A patient mobile application, a caregiver dashboard, and an extended ePRO application. The CoroPrevention mobile application acts as a digital companion, which supports patients in making behaviour changes in their daily life and adhering to these healthy behaviors on the long-term in order to control CVD risk factors.

In this paper, we discuss the process of developing audio-visual content for the CoroPrevention mobile application. In addition to presenting the project in general, we also give examples of the designed content and describe some of the challenges of managing a project in an international, cross-cultural and interdisciplinary project during the challenging COVID-19 pandemic.

II. PREVENTING CORONARY HEART DISEASE (CHD)

A heart attack is a consequence of a blocked artery caused by a build-up of cholesterol in the coronary arteries. Lifestyle factors, such as smoking, high cholesterol, high blood pressure, diabetes, overweight, stress, physical inactivity, and unhealthy diet increase the risk of CHD significantly. Patients with a recent heart attack have increased risk of developing recurrent heart attacks and hospitalisations [5]. Therefore, secondary prevention [6] is important. Secondary prevention consists of prescribing guideline-based medical therapy and improving lifestyle-related risk factors.

The goal of secondary prevention is to lower the risk of a recurrent event. The starting point is education, i.e., teaching patients how heart disease develops, what is dangerous for the heart, and what can help protect them from a new heart attack. Secondary prevention is comprised of different core components such as (increase in) physical activity, smoking cessation, nutritional counselling, medication adherence and stimulation of psychosocial wellbeing. [6]

It has been shown that patients who have a clear understanding of their after-hospital care instructions are 30% less likely to be readmitted or to visit the emergency department than patients who lack this information [7]. However, it is estimated that 40-80% of the medical information provided by healthcare workers during rehabilitation or consultation is forgotten soon after [7]. Given the short time available for consultations (with an average of just about 10 minutes per patient), patients are overwhelmed by a lot of information [8]. One potential way to avoid this information overload and improve patients' health literacy is to use different audio-visual platforms.

E-learning can be an interesting alternative form of education, allowing cardiac patients to watch educational videos whenever and as often as they want to. It is known from the literature that the education of patients via a video platform results in better patient outcomes, better risk factor management and more awareness of their disease condition [9][10]. E-learning videos may also be more appealing to patients because they are short, use both visual and auditory

elements, display reliable correct medical information, and may contain real patient experiences. However, contemporary e-learning solutions [11][12][13] lack personalization and shared decision making and as a result, overwhelm patients with large amounts of information.

The information given to the patient through the internet can also be individualized. It can be pushed to the patient at the right time depending on the targets set for the secondary prevention program, the medical situation, the current level of motivation for certain behavioral changes, and the evolution of the patient. To optimize the effectiveness of the videos, it is important that the information is matched to the knowledge level of the patients and that the patients consider the videos as reliable.

III. THE COROPREVENTION PROJECT

"CoroPrevention: Personalized Prevention for Coronary Heart Disease" [14] is a multiyear, EU-funded Horizon 2020 research project aiming to shape and implement a personalized secondary prevention strategy for patients with established CHD. The project studies 12.000 patients from six EU countries using individual patient's medical histories, conditions and circumstances. 2000 high risk patients will be further selected for a randomized clinical trial (RCT) (Fig. 1).

With advances in genomics, data and informatics, and wearable technology, the project's objective is to significantly reduce the number of coronary events, as well as lower morbidity and mortality associated with CHD. We estimate that the CoroPrevention programme will reduce the cardiovascular event rate by 25% in high-risk patients - with annual savings of tens of billions of euros to the EU.

The multidisciplinary consortium members (Fig. 2) include 22 clinical cardiovascular centers from seven European countries (Belgium, Finland, Germany, Greece, Italy, Poland, and Portugal), several universities, companies providing various analytical services, a software company, and the European Society of Cardiology (ESC) [15]. The members have over 20 years of expertise in CHD research that has resulted in over 1000 publications.
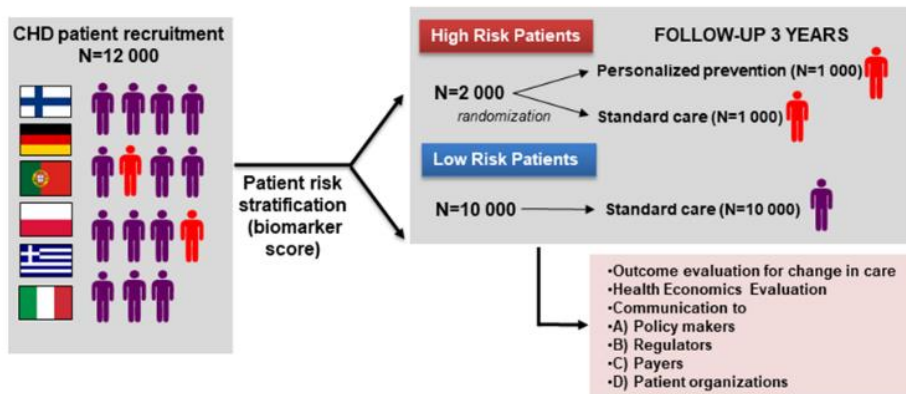

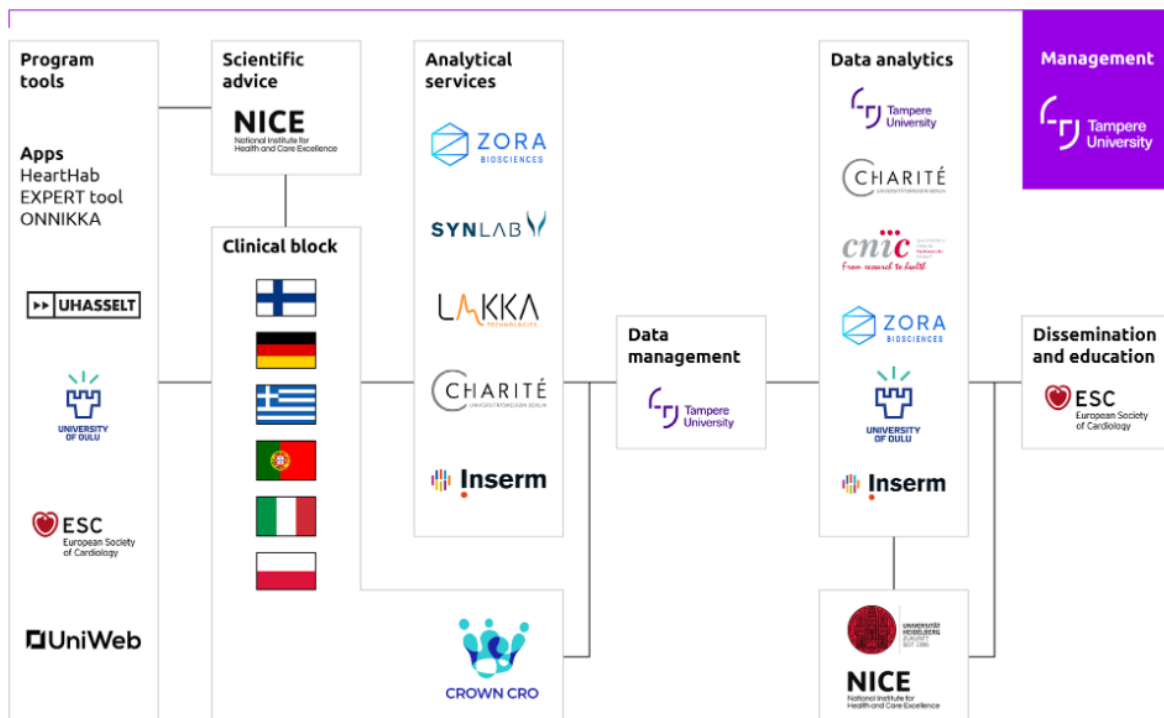Fig. 1.   Overall structure of the CoroPrevention randomized clinical trial.

Fig. 2.   CoroPrevention consortium members.

The CoroPrevention programme will not only validate new tools, but it will establish a new economically sustainable personalized treatment practice applicable throughout Europe, particularly to those regions where CHD prevention needs upgrading. The main methods in CoroPrevention include a personalized prevention program (PPP) supported by the CoroPrevention Tool Suite (designed by the Universities of Hasselt and Oulu), a randomized controlled trial (RCT) to pilot the PPP, and a novel biomarker based CoroPredict score for identification of very high-risk CHD patients. The RCT will be carried out at 24 study sites located in Finland, Germany, Greece, Italy, Poland and Portugal. Included are also health economics and health technology assessments, which are needed for communication and dissemination of results by ESC to physicians, relevant health authorities and policy makers.

The digital platform supporting the CoroPrevention care pathway, i.e., the CoroPrevention Tool Suite, consists of three applications: A patient mobile application, a caregiver dashboard and an extended ePRO application. The design of the digital tools is informed by human-computer interaction and behaviour change theories in order to maximize its positive effect on the patients.

The caregiver dashboard visualizes the patient's cardiovascular risk profile and supports the case nurse and patient in deciding together on healthy lifestyle goals based on the patient's progression and personal preferences. The caregiver dashboard also includes two decision support systems that provide easy access to the latest relevant ESC guidelines and scientific evidence relevant to CHD: 1) the EXPERT tool [16][17], which is an interactive system for exercise prescription recommendation, and 2) a guideline-based medication prescription system, aimed to support physicians in prescribing the necessary medication for secondary prevention of CHD.

The CoroPrevention mobile application acts as a digital companion, which supports patients in adhering to their healthy lifestyle and changing their behaviour to control CVD risk factors (sedentary life, smoking, obesity, stress, hypertension, hypercholesterolemia, hyperglycaemia).

The extended ePRO application is used on a tablet in the waiting room as preparation for the shared decision making (SDM) consultation with the case nurse. The ePRO application collects patient preferences and Electronic Patient-reported Outcomes (ePRO) in a cost-effective manner. The results are used to facilitate the discussion between case nurse and patient during the SDM encounter.

The audio-visual content that was developed by Tampere University of Applied Sciences (TAMK) is spread over the three different applications as follows.

- In the extended ePRO application, patients can view a video that provides general information about the CoroPrevention study.

- In the patient mobile application, all audio-visual content is offered in a library. Patients can choose which videos they want to view and when. Furthermore, there are reminders when new storyline videos become available and when there is relevant educational content sent to the patient by the caregiver.

- In the caregiver dashboard, audio-visual contents are used to support the SDM discussion (e.g., instruction videos illustrating strength training exercises). Furthermore, relevant educational content for the patient can be selected during SDM, or sent remotely to the patient's mobile application.

IV. CREATING AUDIO-VISUAL CONTENT FOR THE COROPREVENTION MOBILE APPLICATION

To create interesting motivational audio-visual content for the CoroPrevention Tool Suite (especially the CoroPrevention mobile application), Tampere University of Applied Sciences (TAMK) was asked to join the consortium. Due to TAMK's diverse curriculum and practical training included in the studies, it was estimated that the university would be able to recruit talented students for all parts of the project, including concepting, scriptwriting, animation, music, and video production.

Planning started already at the end of 2019, when the first rough plans for the content were created. It was concluded that the audio-visual material developed in the project should serve as a large library, from which items can be chosen by the patients, or which can be (automatically or manually) sent to the patient based on his/her plans and needs at a certain moment in the prevention program. It was also speculated that a stand-alone YouTube channel alone may not be attractive enough to the participants (mean age 65 with differing digital literacy). In addition, as every patient will be enrolled in the RCT for 3 years, periodic updates of the educational content can be a means to attract patients and engage them with the app. Therefore, pushing the video series at certain time points during the secondary prevention program through the mobile app seemed most appropriate.

The plans started taking their final shape in the project's very fruitful kick-off meeting, which was arranged in Nice in February 2020. The overall tone of the educational content had already been planned using mood boards, and it was now agreed that the storyline videos would be based on the story of an older man, his son, and an older woman, all of whom had or would suffer from a heart attack.

The leading theme was a positive approach to a healthy lifestyle and CVD prevention. Patients often experience secondary prevention as a punishment, in which things they find pleasant are restricted, and a lifestyle that is considered difficult and therefore less pleasant is encouraged. Thus, the audio-visual material should show how a healthy lifestyle can indeed be pleasant, it should cheer them up, and give them guidance on how to improve their quality of life. The themes of the educational content included, e.g., quitting smoking, losing weight, exercising, proper medication, stress, and healthy diet. These themes were identified based on earlier studies performed by the University of Hasselt [13] [18].

TAMK's work was divided into three separate work packages: 1) storyline videos, 2) animations, and 3) testimonial videos. At a later stage of the project, an extra package 4) consisting of an informational animation and 15 extra instruction videos was added. While the 1st author of this paper worked as a project manager on TAMK's side, taking care of all kinds of practicalities and collaboration between all parties of the project, work packages 1-3 also had their own leaders. Two teachers with experience in scriptwriting and TV productions handled package 1, two animation teachers took

care of package 2, and one video professional was responsible for package 3.

After careful planning, we decided to implement 13 storyline videos, 20 testimonial videos, and 13 animations. While animations can be more expensive and time-consuming to create than videos, they can also be a strong tool to give patients background information about a specific more technical subject and to make things easier to understand. They are also a good means to visualize concepts that would be difficult to implement with actors (e.g., what happens in the blood vessels or what is cholesterol).

The topic of each piece of content was specified by doctors and researchers from Belgium (University of Hasselt and Jessa Hospital), and the deadline for all the content (including translations to seven languages and dubbing) was set to the end of 2020. As the project included so many parameters and parts requiring medical expertise, it was also agreed that TAMK would do their work in several stages, and that each stage would have to be approved by the Belgian medical experts before moving to the next stage. In some instances, TAMK would even need approval from the leading doctors of all seven countries (Belgium, Finland, Germany, Greece, Italy, Poland, and Portugal) involved in the project.

A. Storyline videos – Phase 1

Packages 1 (storyline videos) and 2 (animations) were partially linked to the contents and timetables of TAMK's spring semester curriculum. Thus, the work for package 1 started in March 2020 (Fig. 3), the first task being scripting. During the spring, two scriptwriting students wrote 13 episodes of storyline videos using the European Society of Cardiology (ECS) [15] and Healthy Heart web pages [19] and information received from the doctors as their main source of information.

Soon after starting the work, we learned that patients enrolled in the RCT would not necessarily watch all the videos sequentially; for example, a non-smoker would not watch smoking-related videos. Thus, it was requested that the episodes could be watched in any order. While this initially caused some problems for us, they were solved by clever scriptwriting. In the end, we also decided to add cliffhangers at the end of most episodes to get the patients hooked and encourage them to watch all the episodes.

The final storyline goes as follows. In the beginning, a son goes to meet his father at the hospital after he has suffered from a heart attack. They also meet another patient called Maria and gradually become good friends. Father, son and Maria start exercising and making other healthy lifestyle changes, until in the final episode of the series all three start their well-earned holiday.

The contents of the individual episodes include, e.g., the importance of visiting your doctor regularly, alerting symptoms of CHD, performing CPR (cardiopulmonary resuscitation), familial risk factors, losing weight, different types of physical exercises, quitting smoking, getting back to work, and the importance of cardiac rehabilitation programs.

As every detail of the story had to be approved by experts in Belgium, the work was done in several stages including several rounds of iteration. Furthermore, as the animations would also be based on the same characters, we had to write the scripts very carefully to not cause unnecessary problems in the latter phases of the project.

Scripting storylines	Mar 1, 2020	May 31, 2020	
Recording English voice-over reference	Jun 1, 2020	Jun 30, 2020	
Preparations (casting etc.) for storylines	Jun 1, 2020	Aug 31, 2020	
Shooting storylines	Sep 1, 2020	Sep 30, 2020	
Editing storylines	Sep 1, 2020	Nov 30, 2020	
Music and SFX for storylines	Sep 1, 2020	Oct 31, 2020	
Translating storylines	Oct 1, 2020	Nov 30, 2020	
Voice-overs for storylines	Oct 1, 2020	Nov 30, 2020	
Final edits + deliverables	Dec 1, 2020	Dec 31, 2020	

Fig. 3. Gant chart for implementing the CoroPrevention storyline videos. Dates have been rounded to the nearest start or end of the month.

Due to the extremely good collaboration between all parties, the scripts were finished on time in May 2020. Immediately after that, the English voice-overs to be used as a reference in dubbing were also recorded. We were also planning to shoot the videos in June, but this work had to be postponed due to COVID-19 restrictions of that time.

B. Animations

The animation team started their work roughly at the same time as the storyline team, i.e., March 2020 (Fig. 4). Again, the work was done in several stages.

First, one student created the three characters (father, son and Maria) using three different animation styles, out of which the Belgian medical and HCI experts were then able to select their favorite style. Two other students then wrote scripts for the 13 animations. This time the topics included, e.g., the influence of stress and relaxation on the heart, how to read nutritional information, alcohol, and function of the heart.

The scripts were again iterated in collaboration with the Belgian experts, and the final scripts were approved in May 2020. Soon after this, the English voice-overs were also recorded.

Scripting animations	Mar 1, 2020	May 31, 2020	
Recording English voice-over reference	Jun 1, 2020	Jun 30, 2020	
Implementing animations	Jun 1, 2020	Sep 30, 2020	
Music and SFX for animations	Aug 1, 2020	Sep 30, 2020	
Translating animations	Oct 1, 2020	Oct 31, 2020	
Voice-overs for animations	Oct 1, 2020	Nov 30, 2020	
Final edits + deliverables	Dec 1, 2020	Dec 31, 2020	

Fig. 4. Gant chart for implementing the CoroPrevention animations. Dates have been rounded to the nearest start or end of the month.

Fig. 5. Screenshots from the CoroPrevention animations.

Next, five students started designing and implementing the English reference animations. Each person had a clear role varying from character design to programming, and the tools used included, e.g., Blender, Adobe AfterEffects, and Photoshop. The work took the entire summer. To guarantee the quality of the work, TAMK's animation teachers were also in contact with the students during their summer holidays.

Despite the minimal guidance, the work progressed extremely well, and all the animations were ready in August 2020, with the exception of one more difficult animation that was not finalized before September 2020. Fig. 5 depicts some examples of the final animations.

C. Testimonial videos

The University of Hasselt's earlier research with e-learning in a large population of CVD patients [18] showed that the use of short videos of patients and caregivers is seen as "honest" and convincing. Therefore, we decided that such videos should be used to address all aspects of life after a heart problem.

For the study of Frederix et al. [18], the University of Hasselt already shot several testimonial videos related to coronary diseases. However, as the real patients did not feel comfortable in front of a camera, the outcome of the videos was not always optimal. In the case of CoroPrevention, the medical experts decided that the only way to guarantee the desired outcome was to hire professional actors to read scripts written by the medical experts.

Unfortunately, this also created the problem of "fake" testimonials. After discussions with our lawyers, it was decided that we should add a short text to each video explaining that the persons in the videos were actors instead of real patients.

TAMK started filming the testimonials in June 2020 just before their holidays (Fig. 6). An older actress (60+ years) and a younger but smoking and overweighted actor were hired. The actors read their scripts from a teleprompter in front of a green screen, enabling us to change the background to our liking later in post-production.

Due to COVID-19, it turned out that approximately half of the videos had to be shot in Belgium in the end of June 2020 when TAMK people were already on holiday. Instead of using actors and a professional film crew, the University of Hasselt and Jessa Hospital had to rely on real medical professionals and the university's audio-visual (AV) department to make the videos. Unfortunately, the AV personnel did not follow TAMK's instructions and tips carefully enough, resulting in colorless and slightly boring-looking videos. The choice of grayish background color also prevented TAMK from changing the background and doing some other edits.

During the summer, one TAMK student started editing both UHasselt's and TAMK's testimonial videos. However, he faced several difficulties in the work, and without constant guidance, the work was not finished on time. The edits had to be finished later by one of TAMK's teachers, causing a delay of several weeks.

All testimonial videos (10 in total) were finally approved in September 2020. Fig. 7 depicts some examples of the final testimonial videos.

Scripting testimonials	Feb 1, 2020	Apr 30, 2020	
Shooting testimonials	Jun 1, 2020	Jun 30, 2020	
Editing testimonials	Jun 1, 2020	Sep 30, 2020	
Music and SFX for testimonials	Sep 1, 2020	Oct 31, 2020	
Translating testimonials	Oct 1, 2020	Oct 31, 2020	
Voice-overs for testimonials	Oct 1, 2020	Dec 31, 2020	
Final edits + deliverables	Dec 1, 2020	Dec 31, 2020	

Fig. 6. Gant chart for implementing the CoroPrevention testimonial videos. Dates have been rounded to the nearest start or end of the month.
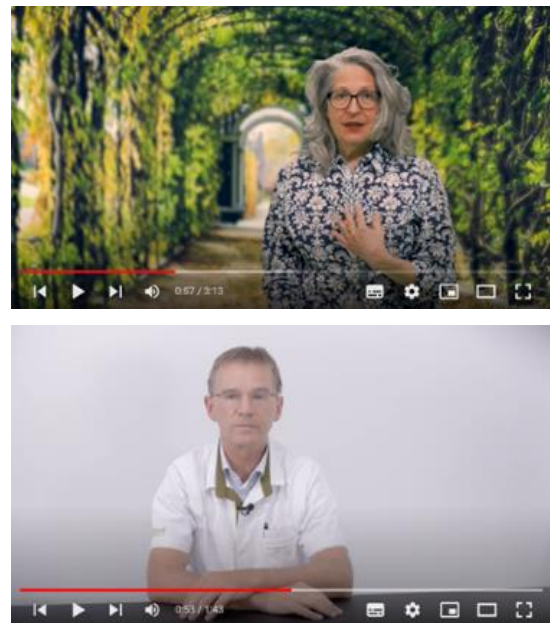

Fig. 7. Screenshots from the CoroPrevention testimonial videos.

D. Storyline videos – Phase 2

According to the original plan, TAMK was supposed to shoot the storyline videos already in June 2020, but this work had to be postponed due to COVID-19. After making some calculations, we realized that if we could not start shooting in the beginning of Autumn 2020, the entire project would be delayed. Thus, we hired three producer students to start the casting process, arrange clothes and props, scout locations, plan shooting schedules, and take care of all kinds of practical arrangements already during the summer.

The actors were selected and hired immediately after our summer holidays in Autumn. As the COVID-19 situation had luckily gotten slightly better, we were able to shoot all storyline videos during a single week in September 2020. In addition to three actors, the film crew consisted of a director, three producer students and three technical persons (audio, camera, and lights). To make sure that CPR was performed correctly in the videos, we even had a real doctor present.

During the CPR shot, the dog used in some of the shots ended up biting the actor of father, as it thought that he was harming the son. While this did not cause much delay in the schedule, some shots ended up including a bandage on the father's hand.

Post-production work started immediately after the videos were shot. Again, this part caused us the most trouble; there were several confusions, some communication problems, and certain students had "attitude problems" causing this phase of the project to be late by several weeks.

The videos were finally finished in October 2020. Fig. 8 depicts some examples of the final storyline videos.

Fig. 8. Screenshots from the CoroPrevention storyline videos.

E. Translations

After all storyline and animation scripts had been approved in May 2020, it was time to start thinking about the translations and dubbing. Due to the high number of scripts (13+13+10 in seven languages), the estimated cost was tens of thousands of euros, and thus we had to start a competitive tendering process. Due to summer holidays, which were at different times in different countries, the entire process was not completed until September 2020. In the end, the job was given to an English company called Voquent [20].

Voquent started working on the translations in October 2020. After a couple of iteration rounds, all the scripts were approved by the contact personnel (doctors) of all seven countries. The doctors also selected the voice talents to be used in the videos and animations by browsing through Voquent's online audio library.

Unfortunately, Voquent could not start dubbing all the content yet, because one essential element, music and sound effects (SFX), was still missing from most pieces of content.

F. Music and sound effects

To our surprise, the most problematic part of the entire content creation process ended up being music and sound effects (SFX).We had presented the project already in the beginning of 2020 to a group of sound design students, and a couple of students expressed their interest in taking part in the project. However, as the videos and animation were still at such an early stage, the teacher of the course felt that they should not start working on the topic. Instead, he said that he would personally design and compose all the content later.

Despite many messages prompting him to start planning the music as soon as possible, he did not do anything before receiving the English reference content. Thus, the music and SFX for the animations were done as late as August and September 2020, while for the testimonial and storyline videos they were done in September and October 2020.

Before composing the final content, the musical style was first discussed with researchers of Hasselt University. In some cases, 1-2 iteration rounds were required to find the correct style.

G. Recording voice-overs, finalizing and delivering the content

Due to delays in composing the final music and SFX, we were not able to start dubbing the content before the end of October 2020. Thanks to Voquent, this part of the project went extremely smoothly, and we received all the files within the promised schedule during November and December. During the most hectic phase of the project, Voquent even had to ship parts of the content to us on a hard drive, as sending the files using WeTransfer (or similar) would have been slower. Due to the COVID-19 pandemic, people had to work at home instead of at an office or university, which also meant that the network connections were often slower than usual.

Before sending the dubbed content to the doctors, we still had to fix a couple of things. While we had taken into account that the scripts had slightly different lengths in different languages and some languages were faster to speak than the others, some of the dubbed videos still ended up being too fast; there simply was not any space between the different sentences. To solve the problem, we ended up slowing some videos by 10%, which did not seem to degrade the perceived quality too much. Also, despite all our attempts to avoid having any text in the videos, a couple of videos had to have translated subtitles. These videos naturally had to be edited one by one for each language.

After finalizing the content, we still had to upload all the content to YouTube with correct description texts and file names, send download links to numerous contact persons, and do several other small tasks. To track the progress and make sure we would not forget anything, all these tasks were listed in a single Google Sheets document. All the files and languages combined, the document ended having approx. 5000 cells, where one cell included one operation that had to be done! Going through the entire sheet took approx. 3-4 working days from four persons (= the first of author of this paper + three students). Unfortunately, one of the students was not that careful in his work, resulting in double-checking by the others.

As the last step of the project, every piece of content was again checked by the contact persons (i.e., medical experts) of each country. Unfortunately, new kinds of problems started to occur.

While all the countries had approved the translated scripts - based on which all the content had now been dubbed and edited - some countries now reported errors in the translations. The most typical explanation was "Sorry, we did not check them carefully enough!" Unfortunately, this meant that Voquent had to re-record some of the voice-overs, and after that TAMK and the medical experts had to check the videos again. This naturally also caused some extra costs and delays for the project. On top of that, we also noticed problems with some of the music, meaning further edits to some of the videos. Despite several requests emphasizing the importance of the changes, these minor edits took several days to fix.

After a couple of painful iteration rounds, all the content was delivered to each country by Christmas Eve, meaning that the first author of this paper had lost three days of his Christmas holiday. As this delay could have been avoided by designing the music and SFX on time, this resulted in heated messaging and discussions, and finally a "crisis meeting" in January 2021.

H. Cross-cultural design

When preparing the content, our goal was always to make it as generic as possible. The content should not include any activities, food, etc. specific to a certain country, it should not offend anybody, and the patients should always be able to identify themselves with the characters shown in the videos.

To simplify translations and the final edits of the content, our original goal was to use zero subtitles. However, during Autumn it became evident that they could not be completely avoided. For example, it turned out that in Poland mild alcoholic drinks such as beer and wine were not often considered to be alcohol. Thus, our spoken instructions "max. 1-2 alcohol portions per day" could then be considered as 1-2 portions, i.e., one glass, of vodka. For some of the videos, we had to add translated subtitles explaining that in this context the term alcohol also included beer, wine, etc. Unfortunately, this type of "minor" changes also meant that we had to edit eight (English + translations) different versions of each video and send them for another round of approvals.

Many other cross-cultural issues were also taken into account, but thanks to our international network of doctors, most of them were handled in the early scripting stage. For example, in our original storyline scripts Maria and the father started dating. As both were divorced, we did not see that as a problem. However, we were then instructed that this would be unacceptable in some conservative parts of southern Europe. As changing Maria to a widow did not help, the scripts were changed in such a way that Maria and father were only friends and their physical contacts were minimized. To give yet another example, as the "thumbs up" sign can also be used an insult in some countries (incl. parts of Italy and Greece), it was removed from the animations.

I. Extra animations and videos

During the year 2020, a total of (1+7)*46=368 videos and animations were prepared in roughly nine months. Pleased with the outcome, in 2021 the CoroPrevention project management decided to purchase more content from TAMK. This additional content included one welcome video, one informational animation describing the goals of the CoroPrevention project, three BLS (Basic Life Support) videos (Fig. 9), and 10 instruction videos for physical exercises. For most of these videos, the video recordings were done by the University of Hasselt, whereas editing was done by TAMK.

In total, (1+7)*15=120 extra pieces of content were prepared. As we already had one year of experience and the content was also simpler, the process was now quite straightforward, and everything went smoother than during 2020. The work was started in March 2021, and it ended already in April.

Fig. 9. Screenshot from a CoroPrevention Basic Life Support (BLS) video.

V. PROJECT MANAGEMENT TOOLS AND PRACTICES

Due to the COVID-19 pandemic and the international and multidisciplinary nature of the project, the project was managed mostly online. In addition to the project's kick-off meeting in February 2020, TAMK's project manager (the 1st author of this publication) never met the other consortium members face-to-face. Communication was done mostly using email, Google Drive and OneDrive; even Zoom was not used, as it started to get more popular only slightly later during the year.

Most of TAMK's internal meetings were also arranged online. The project manager met the storyline scriptwriters and their teacher face-to-face approximately five times, and the entire animation team only once just before more COVID-19 restrictions started taking place. During the rest of the year, the work was conducted using Google Drive, OneDrive, Outlook, WhatsApp and occasional phone calls.

During the summer, the project manager decided to attend the testimonial video filming sessions just in case any kind of help would be needed, but he ended up sitting most of the time outside the room working on other tasks. In the case of storyline videos, he did not take part in the filming sessions at all; as the COVID-19 restrictions had again become stricter, TAMK was forced to limit the number of people attending the sessions. All post-production work was done online without any physical meetings taking place.

The progress of the project was followed using Trello. We also experimented with Gant charts etc., but they did not seem to give any extra benefit to us (the charts shown in this paper were created later for the purposes of this publication). Trello combined with occasional shared Google Sheets etc. worked extremely well for all our purposes.

VI. CHALLENGES IN PROJECT MANAGEMENT

While the project was finished on time, managing a content creation project of this size in a multinational and multidisciplinary environment was not always easy.

As TAMK had to work very closely with the University of Hasselt, we quickly learned the correct ways to collaborate. Each party respected each other's work, communication was quick and fluent, deadlines were almost always met, and we did not have any major problems during the entire year. While the parties did not originally speak the same "professional" language, this was never a problem; TAMK received enough background information on CHD, and as the content was created for the laypersons instead of doctors, the used terms etc. were not too difficult to understand.

However, the project included several other parties – mostly doctors from different countries - as well. From TAMKs perspective, the main problems in working with these parties were the lack of doctor's resources and the cultural differences in managing deadlines.

In many cases, most countries sent their feedback just before the deadlines or a couple of days late. Not so surprisingly, quite often the leading doctors had more urgent things to do than reading our animation scripts. Based on our earlier experience in project management, we had taken this type of delay into account in our planning; whenever we had set a certain deadline for the doctors, from our perspective the actual deadline was approximately one week later. However, in some cases the delays were intolerable. From our

perspective, it seemed that certain doctors did not fully understand the importance of our deadlines, or they simply did not care. For example, a translated script that was not accepted on time also meant that the voice-talents were not able to start recording, which then delayed the final edits, etc. In some cases, the delays were almost one month, which complicated our work quite a lot.

There was one assigned contact person that never answered a single email throughout the year, and this person was later replaced by a volunteer from the same country. As the volunteer had not reserved any "official" working hours for the task, her replies were often late, and she sometimes had to work during the weekends as well.

Even though the content was created in stages, and the deliverables of each stage were accepted in each country before moving to the next stage, the representatives of one country sometimes changed their mind. For example, while all the translations had already been accepted before moving to dubbing, the representatives demanded changes to the videos after the final dubbings and edits had been done. From our perspective, this meant that we had to buy new translations from Voquent, increasing the total cost of the project, and their voice talents had to re-record their parts. In addition, the videos had to be edited again, uploaded to YouTube, sent to another round of approvals, copied to our backup drive, etc. Just before Christmas, every change that maybe looked insignificant to the doctors actually created lots of extra work, extra costs, and extra stress for us.

VII. DISCUSSION AND FUTURE WORK

In this paper, we presented the process of developing audio-visual content for the CoroPrevention patient mobile application. In addition to giving examples of the designed animations, storyline videos, and testimonial videos, we also discussed our project management practices and tackled the challenges of working in an international, cross-cultural and multidisciplinary environment.

From TAMK's perspective, the project was a success. Despite extra challenges caused by the COVID-19 pandemic, we were able to deliver almost 500 pieces of content (incl. the dubbed versions) on time. Despite the occasional stress and overtime, CoroPrevention was an extremely interesting project to work with, and it was also a great learning experience for all persons involved. We were able to integrate the project with many university courses, and the project provided important training for the students plus salary to support their otherwise low income. While there were problems with some individual students, the most talented and pedantic ones were always able to fix the errors of others, and thus we ended up giving more responsibility to them towards the end of the project.

TAMK's part of project is now 99% done; there is still a chance that we will have to update some of the videos should they include any errors or receive negative feedback from the patients. We are also considering to design a "consent form animation" to give a summary of the long informed consent documents that patients have to read at the beginning of the study.

After delays caused by COVID-19, the RCT will start soon, in the beginning of 2022. We have high hopes that the patients will find the designed digital content interesting and inspiring, and that the RCT will reduce the number of coronary events as planned. While the long-term research will take several years, the results will be published in various scientific conferences and journals as soon as they come available.

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