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**To cite this article:** Laura J. Wilde, Carol Percy, Gillian Ward, Cain Clark, Petra A. Wark & Louise Sewell (18 Jan 2024): The experiences of people with chronic obstructive pulmonary disease (COPD) using activity monitors in everyday life: an interpretative phenomenological study, *Disability and Rehabilitation*, DOI: [10.1080/09638288.2024.2304095](https://doi.org/10.1080/09638288.2024.2304095)

**To link to this article:** <https://doi.org/10.1080/09638288.2024.2304095>



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Published online: 18 Jan 2024.



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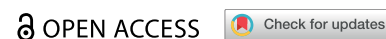


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RESEARCH ARTICLE



# The experiences of people with chronic obstructive pulmonary disease (COPD) using activity monitors in everyday life: an interpretative phenomenological study

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## ABSTRACT

**Purpose:** Understanding the experiences of people with Chronic Obstructive Pulmonary Disease (COPD) using activity monitors in daily life could support the utilisation of technology within healthcare to increase physical activity and support self-management. This qualitative study aimed to explore the experiences of people with COPD using activity monitors at home in everyday life.

**Methods:** Semi-structured face-to-face or telephone interviews were conducted with seven people with COPD between August 2018 and June 2020. Participants had all used an activity monitor within the last year (Fitbit, Garmin, or Apple Watch). Interviews were analysed in-depth using Interpretative Phenomenological Analysis (IPA).

**Results:** Four themes, developed using IPA, highlight participants' engagement with activity monitors and integrating them into their lives: (1) Motivational features to monitor activity, (2) Importance of setting achievable goals, (3) Developing knowledge and awareness, and (4) Integration into everyday life for self-management.

**Conclusion:** Activity monitors were perceived to be beneficial and useful to people with COPD, not just for monitoring their activity, but also helping to self-manage their condition. Activity monitors may be a useful tool within rehabilitation and healthcare services for COPD.

## ARTICLE HISTORY

Received 6 August 2023  
Revised 3 January 2024  
Accepted 5 January 2024

## KEYWORDS

Activity tracker; exercise; physical activity; pulmonary rehabilitation; respiratory care; respiratory disease; self-management; wearable technology

## > IMPLICATIONS FOR REHABILITATION

- Activity monitors were beneficial for people with Chronic Obstructive Pulmonary Disease (COPD) to monitor their physical activity and support self-management of their COPD.
- People with COPD could see and make sense of their activity levels, set activity goals and increase their motivation from the objectively monitored activity.
- Activity monitors can help to support individual goal setting and facilitate ownership, but support is needed to set achievable and realistic goals.
- Healthcare practitioners need to be aware of the potential negative effects of using activity monitors on mental or physical health and wellbeing and support people with COPD to manage pressure and expectations of meeting their goals.



## Introduction


Chronic Obstructive Pulmonary Disease (COPD) is a progressive lung disease where symptoms can include breathlessness, coughing and sputum production. Physical activity (PA) can increase life expectancy, reduce hospital admissions, and improve the quality of life of people with COPD [1, 2]. Activity monitors (e.g., apps and wearables) are becoming increasingly utilised by people in everyday life [3, 4]. Increasing daily walking distance can positively influence health and reduce acute exacerbations in people with COPD [2, 5, 6]. Activity monitors may have a role in negotiating person-centred goals during pulmonary rehabilitation and supporting the achievement of exercise and activity goals [7].

Previous research has focussed on using activity monitors for monitoring PA, often as an objective research measure and/or to

see if the monitor itself can facilitate increases in PA levels [8]. Interventions using activity monitors to promote PA as a stand-alone intervention or alongside pulmonary rehabilitation can increase daily activity levels in patients with COPD [9–11]. A scoping review concluded that people with COPD found activity monitors easy to use and useful to increase PA [12]. Despite frustrations with activity monitors, due to technical and synchronisation issues that sometimes occur, the use of such technology is acceptable to people with COPD [5, 12–14]. Most studies in the scoping review provided participants with activity monitors to use for a specified time [12]. However, there are differences in how people use technology in a research study (e.g., a randomised-controlled trial) compared to real-world settings [15].

Insight from activity monitor data may help patients with COPD to develop strategies and manage their health in everyday life

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 Supplemental data for this article can be accessed online at <https://doi.org/10.1080/09638288.2024.2304095>.

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[16, 17]. Behaviour change techniques incorporated into activity monitors can include supporting patients to set activity goals and self-monitor daily steps, exercise time and intensity [18]. An in-depth understanding of how people with COPD use activity monitors in everyday life and how they integrate them into their lives is needed. Interpretative Phenomenological Analysis (IPA) methodology enables an intricate exploration into the meanings behind the participant's personal experiences. This knowledge can play a pivotal role in supporting the development and delivery of effective interventions to increase PA and current healthcare practices and services that support self-management, such as pulmonary rehabilitation. Therefore, this study aimed to explore how people with COPD experience activity monitors in everyday life using IPA.

## Methodology and methods

### Methodology

IPA is a qualitative approach to facilitate an in-depth exploration of people's experiences [19, 20]. A central aspect of IPA is that the emphasis is on the experiential claims and concerns of the participant [21]. Phenomenology, hermeneutics and idiography are the key theoretical underpinnings and aspects of IPA. IPA is phenomenological; it attempts to understand the individual's perception, and account of events, or experiences [20]. Hermeneutics is a method known as the "theory of interpretation", which is active within IPA analysis as the researcher interacts with the participant and their data [22]. The current research was conducted with a "multiple hermeneutics" approach [23] where multiple researchers (LW, CP, LS) reflected on the data analysis and sense-making process through feedback and discussion. CP and LS offered valuable insights while challenging the lead researcher's (LW) preconceptions and interpretations. Nevertheless, as interpretation is subjective and CP and LS were not as familiar with the data, LW was careful to remain grounded within the data while taking on board their perspectives and interpretations of the analysis. Additionally, IPA is idiographic where a detailed analysis was conducted on an individual-level basis to make claims about the individual participants before exploring similarities and differences across participants [22].

### Participants and recruitment

Aligning with IPA practice, a purposive and homogenous sample of participants was recruited via social media, relevant charities, and local newspapers/newsletters. All participants self-reported a diagnosis of COPD and could offer experiences on their use of activity monitors (see Table 1 for eligibility criteria).

**Table 1.** Inclusion and exclusion criteria for recruitment eligibility.

Inclusion criteria:	Exclusion criteria:
<ul style="list-style-type: none"> <li>Self-reported clinical diagnosis of COPD (i.e., from a doctor).</li> <li>Within the last year, participants had used or were using, an activity monitor for more than just one day.</li> <li>Available for a face-to-face interview in the Midlands area in the UK, telephone interview or online video or audio-only interview.</li> <li>Be able to read, write and speak in English.</li> <li>Aged 18 years or older.</li> </ul>	<ul style="list-style-type: none"> <li>Currently experiencing an exacerbation (i.e., taking antibiotics and/or steroids).</li> <li>Current self-reported severe psychiatric, neurological, or musculoskeletal condition or unstable cardiovascular disease.</li> <li>Had a hospitalisation one month before taking part in the study due to their COPD.</li> </ul>

Abbreviations: COPD: Chronic Obstructive Pulmonary Disease.

### Data collection

Semi-structured interviews were conducted face-to-face at the participant's home or via telephone using an interview schedule with broad open-ended questions (Appendix A). Participants were given the option to complete the interview over multiple sessions due to potential breathless and fatigue during the interview. All participants opted to complete the interview in one session. The interviewer took extra care to use non-leading questions and prompts. As some interviews were conducted during 2020, an additional question was asked about the impact of the COVID-19 pandemic (i.e., Can you tell me about how COVID has affected your COPD and your physical activity?).

### Data analysis

Data were analysed using IPA, following the six steps outlined by Smith, Flowers and Larkin (2009) [19]. The IPA terminology used follows Smith, Flowers and Larkin (2022) [20]. Initially, the lead researcher (LW) read and re-read each transcript to become immersed in and familiar with the data. While reading, the lead researcher noted descriptive, linguistic, and conceptual comments creating "exploratory notes" using coloured pens on the right-hand side of the transcripts that were printed with wide margins. From the exploratory notes, the researcher constructed "experiential statements" (written on the left-hand side of the transcripts) to summarise the participants' experiences and the researcher's interpretations from the notes, mapping any interrelationships, connections, and patterns (see Appendix B for examples of the process of analysis). Scanned and analysed transcripts were shared with the research team to communicate initial thoughts and interpretations. The researcher then photocopied the analysed transcripts to physically cut them and identify any connections across the experiential statements to create "Personal Experiential Themes." The process of developing Personal Experiential Themes was repeated for each transcript. The researcher created a summary document for the analysis of each participant. The summary documents were physically cut up and arranged to explore patterns, commonalities, and differences across all the transcripts and develop "Group Experiential Themes." The research team met regularly to make sense of and revise the Group Experiential Themes. The lead researcher kept a reflexive notebook throughout the data collection and analysis process, being reflexive and mindful of thoughts that may influence data analysis.

### Positionality and reflections

Author LW has a background in health psychology (MSc) and at the time of the research was studying for a PhD. LW is an experienced qualitative researcher and kept a reflective journal on the research data collection and analysis (Appendix C). Reflections and thoughts on the analysis were shared in supervision with co-authors CP and LS. CP is a qualitative researcher in health with expertise in IPA. LS is an occupational therapist with expertise in pulmonary rehabilitation and COPD. The interdisciplinary conversations added to the quality and depth of the analysis.

### Ethical considerations

Ethical approval was obtained from the Coventry University Ethics Committee (P69266). Participants gave written and verbal informed consent before the interview. Transcripts were pseudonymised and anonymised.

## Results

### Participants

Of the 18 people who completed the online eligibility screening questions, nine participants consented to take part. However, two were unreachable to arrange an interview (see [Figure 1](#) for the recruitment flow chart).

Seven people with COPD participated in semi-structured interviews (two face-to-face, five telephone) between August 2018 and June 2020. Five participants were female, and two were male. Participants ages ranged from 35 to 73 years (mean = 56 years old). See [Table 2](#) for further demographic information. Participants at the time of interview used a Fitbit, Garmin, or Apple Watch. See [Appendix D and E](#) for details of the activity monitors participants used.

Interviews were audio-recorded and transcribed verbatim. Interviews lasted between 51 and 100 minutes (mean = 77 minutes).

### Findings

Four Group Experiential Themes were developed, shown in [Figure 2](#).

#### **Theme 1: Motivational features to monitor activity: “the incentive to carry on”**

Participants’ activity monitors motivated and encouraged them to monitor their activity, be more active and achieve their activity goals. Participants discussed their motivations for starting to monitor their activity, including to be more active, improve their overall health and keep track of their activity progress. At the time of the interview, Hannah had an active lifestyle doing yoga, tai-chi, and being part of a choir. Completing a pulmonary rehabilitation course “spurred” her on to be more active, which she always thought she was. Yet she felt she needed to do a bit more for her health and COPD. Having the activity watch helped her to “step it up a bit” and do more activity to manage her COPD.

So, I think in my mind I’m managing it by being active ... I think I hope [coughs] erm I suppose I am really and generally trying to keep healthy that just I think any anything that you can do, I think is good. (Hannah)

Similarly, Michael was motivated to use an activity monitor to record indoor exercise. Due to shielding during the COVID-19 pandemic, he started exercising at home with workouts from YouTube “to relieve boredom” (30 minutes each, three times a day). During this time, he only went outside to walk his dog for about 10 minutes twice a day.

I like everything about it [the activity monitor] because y’know it tells you how long you’ve worked out for so, so if you want to set yourself a the workouts I’m doing at the moment they’re on YouTube, they only last about 25–26 minutes, so what I do, I pause it at the end of the video and I carry on doing an internal slight, not a fast-paced but a quick walk so that I cover the er thirty minutes. (Michael)

Additionally, Michael wanted to use his watch to keep track of his exercise and help him lose weight. He explained he put on weight due to a career change, with his new job being more sedentary than his previous job. However, due to gyms being closed during COVID-19 lockdown restrictions, using an activity monitor helped him to keep track of his exercise at home.

It was one of them I needed something to track me fitness and me heart rate and everything n because I weren’t doing anything I was just putting the weight on and erm I was I was thinking about joining a gym before obviously before the country went into lockdown and I thought I need something to track me er me exercise... (Michael)

Slightly differently, Chris got his smartwatch to monitor medical-related aspects and his general health. He looked at his activity data and health information regularly; every couple of hours on his phone and could also see it constantly on his watch face, along with “heart rate and everything else”. Even though he found it upsetting to see the deterioration, the watch incentivised Chris to do more and keep trying to be active to improve his fitness. Having information on his previous PA levels and achievements motivated him because he wanted to continue doing as much activity as before.

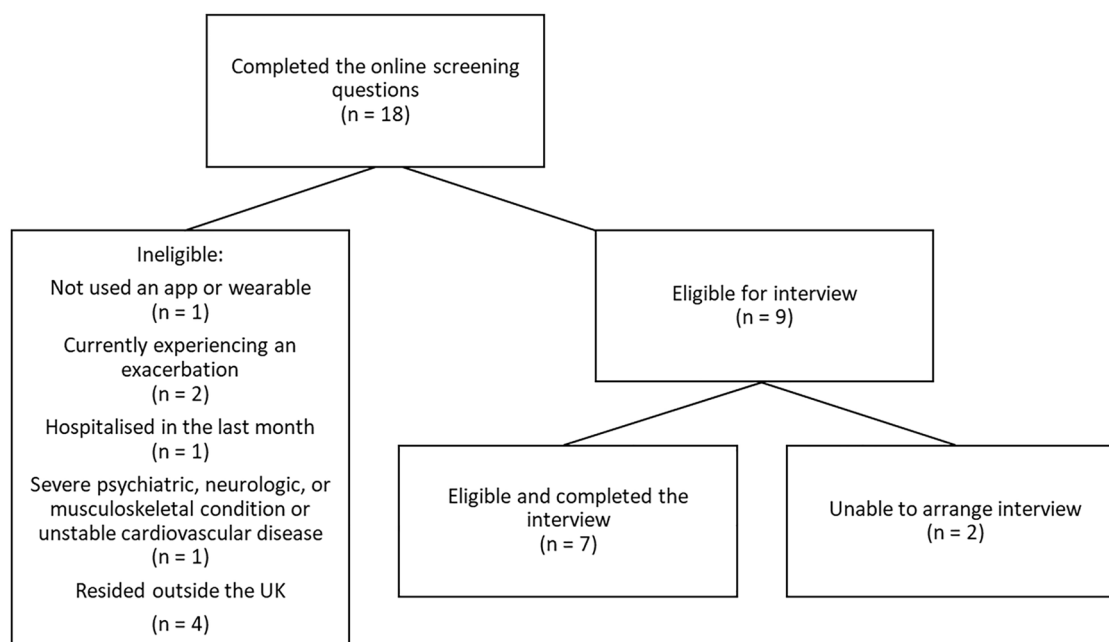


Figure 1. Recruitment flow chart.

Table 2. Participant demographics.

Participant pseudonym	Gender	Lives with:	MRC grade <sup>a</sup>	Treatment received	CAT <sup>b</sup>
Susan	Female	Partner/ Spouse	2	Inhalers, antibiotics, regular exercise	16
Lisa	Female	Partner/ Spouse	2	PR	22
Mary	Female	Partner/ Spouse	2	PR, Seretide, Ventolin	10
Hannah	Female	Partner/ Spouse	2	PR, have three inhalers	16
Nicola	Female	Other	2	PR	9
Michael	Male	Alone	1	Inhalers	24
Chris	Male	Friends	3	PR	28

<sup>a</sup>MRC Breathlessness Scale: Grade 1: Are you ever troubled by breathlessness except on strenuous exertion? Grade 2: (If yes) Are you short of breath when hurrying on the level or walking up a slight hill? Grade 3: (If yes) Do you have to walk slower than most people on the level? Do you have to stop after a mile or so (or after ¼ hour) on the level at your own pace? Grade 4: (If yes to either) Do you have to stop for breath after walking about 100 yds. (or after a few minutes) on the level? Grade 5: (If yes) Are you too breathless to leave the house, or breathless after undressing?.

<sup>b</sup>CAT: COPD Assessment Test represents the clinical impact of COPD: >30=Very high, >20=High, <10=Low, 5=Upper limit of normal in healthy non-smokers [43].

Abbreviations: COPD: Chronic Obstructive Pulmonary Disease; PR: Pulmonary Rehabilitation.

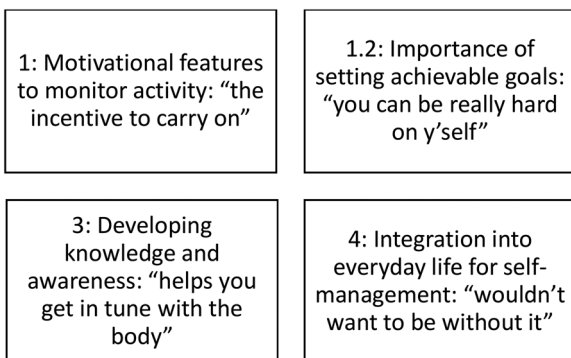


Figure 2. The four group experiential themes.

Basically I just look back at what I can do with my personal trainer now to what I could do 6 months ago erm, I have noticed it's worse, but at the same time it encourages me to keep going, erm to keep sort of using my lungs as much as I can to try to keep them going for a lot longer than possible rather than just I think if I didn't have my watch it wouldn't give me the incentive to carry on, erm but I think because I can look back at memories of what happened what I can do then it kinda makes me want to do the same thing now so it pushes me on a bit. (Chris)

Unlike the other participants, Lisa talked about her motivation to be active when she was not wearing her monitor.

When I take it off, it's a case of ok I've got to try and walk without it and that sounds really strange but sometimes you have to really push yourself to actually walk without it and it's, hmm, ok [laughs] but you can do it. (Lisa)

Lisa's lack of motivation to be active without the monitor indicated that the monitor is an integral part of encouraging her to be physically active. Similarly, Nicola missed the notifications to remind her to move every hour when she was without her Fitbit.

Notifications and reminders, such as to stand or move, were perceived by participants as mostly motivational and encouraging. Participants often used the terms notification and reminder interchangeably as the notification served as a reminder. Michael found the activity watch was "a motivational thing" as he felt constantly connected with the watch with the notifications.

It motivates yer, cos it doesn't leave you alone you know what I mean, I find it motivates you to do more... [coughs] so in that way it's a good thing. (Michael)

The 250 steps-per-hour reminders helped Nicola to move more throughout the day. Similarly, the reminders and prompts were motivational to Chris and gave him a "nudge" to be more active. The notifications encouraged him to "move a lot more", "get up and do something", and meet his "stand quota".

Yeah it just sort of nudges you to get up and do stuff which I like and also the reminders like on my phone every so often it'll buzz and tell me I need to stand or I need to keep moving ... in a nice way so. (Chris)

Although Chris liked the notifications, he also found them annoying if he was in the middle of "doing something".

Some participants enjoyed competitive aspects of their monitors and comparing their PA levels to others was seen as healthy, motivational, and supportive in increasing their PA. Susan loved challenges and felt that getting new technology (such as a computer or Apple Watch) was "a puzzle or a challenge" as well as winning competitions and challenges with friends and family.

Just like I- I like to win, I don't like to, I don't, erm my son in [country]'s got a saying that erm, everything is possible. And erm, I think I'm a bit like that really, I never thought I just think everything's achievable, I don't think that, I don't give in. (Susan)

However, limitations due to their COPD affected their motivation and engagement in challenges and competitions, as some participants felt their condition could not be accounted for. Lisa described how it felt unfair to compete with "normal people" who did not have a health condition and could find it easier to complete the challenges, for example by running. There was nowhere to acknowledge on the device that she had a limiting or restrictive health condition to compete with others experiencing similar challenges.

And you've got people who go cycling and swim and so all that, but as a walker you're up against someone who is running etc so, that can be y'know with the challenges maybe separate them into like I said people who walk people who run people who who do whatever erm, because I think that would be a bit fairer. (Lisa)

Lisa felt when she was up against people that could run, there was no chance she could win the weekly challenges. She also questioned if who she was up against in the challenges were real people or "computer generated with a photo".

Yeah I-I've won some and yeah I ok I do feel quite good about that but then, you do have to look at it in the other sense in the sensible sense, in that are they real people [laughs] y'know. (Lisa)

Although Mary also engaged in competitions, this was among a Facebook group where different people had different goals, and the competition was based on percentages to give everyone a chance of winning. It "seem[ed] like a competition" but was also "not that much of a competition", motivating her to achieve her step goals. She seemed happy winning competitions occasionally but compared herself to others who were "always streets ahead"



and felt she could not beat them. She described the competitions as “like being amongst friends all encouraging each other to do more” and “friendly rivalry”.

Because we are friends it’s great sort of encouraging each other but it’s a friendly rivalry if I do manage to achieve more erm but I’m also a realist in what I’m trying to do with my life. (Mary)

### **Theme 2: Importance of setting achievable goals: “you can be really hard on y’self”**

Setting achievable specific and personal goals was important to participants to keep them motivated. Participants adjusted or created goals personal to them and their daily or weekly activities and sometimes adjusted them when necessary. Each participant had their own goals, which they perceived were achievable and realistic, from daily step goals, such as 10,000 steps, or long-term goals and challenges, like walking up Snowdon or virtually to the moon. Not all participants focused their goals on daily step counts and instead set themselves hourly or weekly goals, including averages. For example, Mary set multiple personal and achievable goals by combining those automatically set by the monitor and ones she set herself covering different time scales (e.g., hourly, daily and weekly). Her goal was 250 steps every hour for 12 hours a day but also to do something constructive in each of her three “blocks” of the day.

I break my day into 3 blocks so I have a morning block, an afternoon block and an evening block and I try to do something constructive in each of those blocks and so each is approximately 4 hours erm so it’s a very rough rule of thumb but it helps me to get things done rather than sitting doing nothing, and so you know 4 and 4 and 4 makes the 12. (Mary)

Another goal of Mary’s was to exercise at least 30 minutes three times a week. Setting various goals worked for Mary giving her something different to aim for and achieve.

There is another thing I like on my Fitbit there looking at it, it has this three of three days exercise so I aim to do erm at least 30 minutes exercise at least 3 times a week erm but I usually get about 6 and er so it encourages me to do that as well today because of the singing setting up and the singing itself I’ve done 49 minutes of exercise. (Mary)

Related to their COPD, Mary and Nicola gradually increased their goals to pace themselves. Mary increased the distance of her walks when she felt comfortable, and they had become easier.

When I first started walking around the block with my husband it was a big deal to go round our shortest block, which was about 1500 steps without a break, but when that got easier to do we devised a slightly longer walk, which was about 3000 steps, and erm we did that a bit more and then erm y’know, when I could manage that comfortably then we would do a further one. (Mary)

Nicola gradually increased her daily floor goal when preparing to walk up Snowdon Mountain. She focused on bigger-picture goals, rather than daily or weekly goals, to maintain her improvements in activity levels and peak flow oxygen compared to when she first started monitoring and was diagnosed with COPD. Her Fitbit helped her to keep track of her activity and progress towards more ambitious goals, such as a faster 5k walk, 5k Pretty Muddy obstacle course, and her virtual walk to the moon. These bigger goals were important to her for motivation and to have something more challenging to work towards than daily or weekly step counts.

I think in July I’ll be doing another 5k... um I’m already thinking of doing a long distance something but I’m not sure what and that will

the Fitbit will be um definitely needed in order to carry out whatever that is because I still need to keep up to a certain... level in my health in order to carry out, carry out anything else um like for example I’d like to walk the Welsh coastline but... but I would love to do that... so in order to do that you need to stay up at a certain fitness level so I will always use the Fitbit to keep me up at that level and to help with any training I may need. (Nicola)

For some participants setting goals, either themselves manually or using the automatically set goals on their devices, added some pressure and expectations for what level of activity they “should” do. Susan and Chris expressed how the goals on the watch also “tells you what you should and shouldn’t do”. Also, Susan used the words “should” and “enough” when referring to the level of activity completed or goals to achieve. It was unclear if these expectations came from herself, the app, or conventional goals (e.g., 10,000). Nevertheless, it was apparent she felt there was a goal she needed to meet. Susan said “yes I’ve done four miles today” when looking at her activity data, suggesting she was happy with her achievement and had met her goals and expectations for that time of day.

It [the activity monitor] makes me aware of what p’haps [perhaps] I should or shouldn’t be doing, and as in I haven’t walked enough or you know, or I’ve just done sommat [something] really stupid. (Susan)

Chris found viewing his PA data throughout the day helped him judge whether his goal was achievable for the remainder of the day. The assessment depended on how he was feeling, what he had already done, what was left to do to reach the goal and the time left to do it. Also, Chris indicated how the Apple Watch determined if he had done enough to “deserve a medal” from correlations over the week, suggesting further expectations and achievements to manage.

Then it’ll correlate that over the week and it’ll work out if you deserve a medal or not, it’s just random little things like that just pops up every so often. (Chris)

In comparison, Hannah was relaxed about her activity data and did not “fret” if she had not done well, saying “it’s information”. Hannah thought she was as active as she needed to be, believing she broadly followed the recommended PA guidelines (what the “health people” suggest), keeping her daily goal at 10,000 steps, even though she did not always meet it. She found the monitor a tool to gain knowledge from and then “accept” her recorded activity implying the goal was arbitrary.

It’s information that you can look at and look at in different ways I I I don’t fret if I haven’t done very well but I like to think oh well that’s not too bad. Y’know it’s it’s a case of er information and and how how one reads it and accepts it and that’s what I feel myself... [coughs]. (Hannah)

Also, Hannah pre-empted any negative talk within the interview about how little activity she had done by saying she did not feel “guilty” and that it did not “depress” her if she could not meet her goals. Hannah justified that she had not achieved her goals due to being busy and not having time, or not wanting to go outside due to the bad weather.

I’m not obsessive as I say I can’t I couldn’t be I’ve got to get I’ve got to get to 10,000 every day because I just couldn’t do that not because of my COPD, probably time [laughs] if anything and it’s it’s the walking outside which when you’ve got really bad weather I’m not going to go out and get soaked and fight the wind just to get steps in... (Hannah)

Mostly, participants gained a sense of achievement from meeting their goals and looking at their activity data. For example, when Nicola looked at her monthly step count and completed challenges, she was pleased and proud of her achievements. Reflecting on her monitoring journey, she compared her step count from the start of using her activity monitor to now and felt “absolutely amazing” and “so proud”.

Ah absolutely amazing because last year I also had pleurisy and I walked up Snowdon um so I've done I had quite busy year last year whereas a couple of years ago I wouldn't have been able to do even half of what I have done. (Nicola)

However, Nicola felt annoyed when she could not reach her goals and brilliant when she could. She explained if she could not reach her goals, she understood and knew it was “for a reason”, which reduced the frustration. She seemed to have learnt and accepted her limits and abilities without putting pressure on herself to do more when she was experiencing a “bad day” and knew that there would be a “good day” in the future when she could achieve her goals.

Aw I feel brilliant if I if I don't manage to reach a certain point at first I was like getting annoyed with myself but now I know well I didn't reach it for a reason but I know I can even if it's a couple more steps tomorrow I will try again tomorrow but if at first I'm not getting frustrated that I can't do something in one day anymore cos I know I'm going to reach it another day. (Nicola)

Lisa apparently did not take much notice of her activity levels. However, during the face-to-face interview, she looked at her data on the computer and was surprised at how many steps she had achieved previously and had increased in comparison to when she first had her monitor. The computer interface gave her more information and a detailed overview of the year compared to what was visible on her app. The surprise was a positive emotion, emphasised through the repetition of “definitely” and many pauses as she was talking and reflecting on seeing her step counts and achievements on the screen.

When actually looking at that now 'cus I don't very often actually look at it on the computer, I normally do it on me phone, I just register it every night on me phone have a quick look and you don't sort of really, take too much notice but actually seeing it there yeah it-it is quite surprising I really didn't erm I just didn't think about it, like that I s'pose... but looking at it on there and just sort'a seeing that, that's just really ah, surprised me ... wow ... yes, that's definitely ha- definitely surprised me, yes. (Lisa)

### ***Theme 3: Developing knowledge and awareness: “helps you get in tune with the body”***

Objectively monitoring and recording activity gave participants something they could see and make sense of. From observing the data, participants learnt and gained knowledge of their activity levels to facilitate perceived increases in PA, management of their COPD and overall health and well-being. For example, Michael and Chris highlighted that the watch and app “tells you” what you've done and your activity levels.

No I mean I like everything about it because y'know it tells you how long you've worked out for. (Michael)

I can set it all on my iPhone- my iWatch and it will tell me how much I've done, how much my heart rate went up to erm I like knowing things like that. (Chris)

Likewise, Susan and Hannah liked they could see objectively what they had and had not done “because it's recorded” and in

front of them. Hannah “can't count [her] own steps”, so the monitor allowed her to “know for sure”. Hannah became aware of what she had done throughout the day or over the week from her monitor, which helped her to increase and maintain her PA levels. Susan found monitoring also helped her to be more aware of her lifestyle.

So I'm more aware that that day I haven't walked enough, or, or if I've had a really hectic day and I've stood up for like 16 hours out of 24, I think oh gosh that was a bit, I should have sat down a bit more but I don't do sitting down so I don't know. Erm, but no, it makes me aware, it makes me aware of my lifestyle. (Susan)

For Nicola, seeing her activity, such as elevation, heart rate and steps, gave her an “idea” of what she was doing and enabled her to “keep an eye” on her activity and health and recognise when she might have been struggling more with her health. The activity monitor evidenced the difference between “good days” and “bad days”; on the bad days, her daily activities were more limited compared to the good days when she could achieve more. This knowledge also translated to monthly where “some months are down and others are up”.

It's more of more of a positive thing to me to keep an eye on things that how it's helping me with my COPD um... I also realise when I'm struggling and just by keeping an eye on how many steps I've done in a day for example if I haven't reached that amount of steps then I know that I must be struggling because I haven't done it because I've got into that frame now where I want to reach it every day... (Nicola)

Nicola's activity monitor helped her to keep “in tune” with her body, facilitating an increase in knowledge and awareness of her PA levels, overall health and COPD. She implied that the watch explained what was going on with her body in a way she could understand and make sense of; it “spells it out to you”. She believed “it's all about knowing your body” and there are multiple ways of doing this and keeping an “eye on things” and how it's helping with her COPD.

I may have COPD but it's not the end of the world anymore and it makes me feel more positive and I can- I can do a lot more. Um so it's, it's more of, more of a positive thing to me to keep an eye on things that's how it's helping me with my COPD, um... I also realise when I'm struggling and just by keeping an eye on how many steps I've done in a day, for example if I haven't reached that amount of steps then I know that I must be struggling because I haven't done it, because I've got into that frame now where I want to reach it every day... [coughs] and like I said it does help remind me to move when I am feeling bit sluggish, so yeah (Nicola)

Even though the participants experienced frustration and disappointment with perceived PA monitoring inaccuracies, it was enough to give them an “idea” or “rough” estimate of their activity and to learn something from it. Susan felt there was a mismatch between her perceived activity levels and the recorded activity. She felt disappointed with her watch for not monitoring her activity as accurately as she wanted it to, which frustrated her because she liked to know and understand the technology.

But I can never understand why, I'm so active but it has to be really- a strenuous activity t-to monitor, for this to register if y'know what I mean, so although it says I've only done two minutes exercise today I've run round like a wotsit [what's it] so, erm and then I I what else do I do. (Susan)

Although Mary was “quite pleased” and “quite happy” with her watch, she noticed inaccuracies in measuring the number of floors climbed. She could not “trust” that metric because she knew she had not been up any floors and the device told her she had.

However, other times she felt the data was generally reflective of her day's activity.

Well because I live in a bungalow it erm it's good for me to try and do some climbing but er I just know not to trust that. (Mary)

Hannah learnt her activity had to be "maintained [to get] your heart rate up and your lungs going" to count as exercise on her activity monitor. Through learning and playing, she got to know and understand the monitor and what it could do. Hannah could not be "bothered" to enter data manually, so she only used the auto-tracking options.

What the Fitbit tells me is activity is a bit more stringent than I would call activity it's it's erm you have to obviously be a certain, dawdling round the shop for half an hour isn't classed as activity on a Fitbit but going you know walking at a certain pace which is a pace that I can easily manage erm is but if you only do it for 5 minutes and then stop it doesn't count it has to be for 10 minutes. (Hannah)

Michael found it difficult to adjust settings and know how to use his watch because he felt he was "not technically minded". Not being "technically minded" had let him down previously because if he had known certain aspects or settings, he would not have sold his old Apple Watch. Michael used Google to help him understand data, like heart rate measurements which were "confusing". Michael explained it was "strange" that he lost more calories than his girlfriend did for the same workouts.

And then cos she's a lot fitter than I am because obviously I'm majorly overweight so she she she sometimes she can, but it's weird because I don't know if it's because she's fitter than me or not but we do the exact same workouts where I will burn like I said I burnt nearly 400 and well 490 calories today she'll do the same workout and she'll only burn 190 so that's a bit strange. (Michael)

Exploring and understanding the features and functions of the monitors seemed to take time for participants, which they did not know instinctively. Making use of the monitor was a "learning experience" where competence to use the technology developed over time as participants made sense of some "strange" and "confusing" aspects. Learning and understanding how their app or device worked, its features and what counted as exercise seemed an important part of making sense of their activity levels and to integrate their activity monitor into their lives.

#### **Theme 4: Integration into everyday life for self-management: "wouldn't want to be without it"**

All participants discussed their life with the activity monitor, how the monitor fit into their life, and assisted with managing their health condition. Some participants integrated the device into their lives to the extent they felt dependent on the device and could not live without it. For example, Chris, Hannah, Lisa, Mary, and Susan felt they would be "lost without it [their monitor]" and "wouldn't want to be without it". Having the watch and data gave Susan a sense of control over managing her health condition and some reassurance. Susan also reacted to the watch's suggestions to "stand" or "breathe", showing obedience to the activity monitor while employing the monitor to help her manage her health.

I usually stand up or I go and make a coffee or I just walk round the park or go and have a look round or, have a walk round, I do take notice, I do, I do listen to what it says like time to breathe I think oh I haven't done that for a bit oh [inhales deeply] deep breathing [laughs]. (Susan)

Nicola talked about being reliant on and "addicted" to the monitor and how she was "maybe... too attached to it". Mary also referred to the watch as a "fitness addiction", indicating some reliance on the monitor.

It's helping me so much to live a much healthier life erm without it erm well I just make sure that I'm just not without it, erm when I go on holiday I plan how I'm going to charge it up, maybe it's like erm a fitness addiction I don't know, erm but erm I wouldn't want to be without it so I make sure that I'm not. (Mary)

Lisa thought that "you can rely on [the monitor] too much", but over time learnt it was ok to leave the activity monitor off and have "time out" from it. Lisa took control of the automatically increasing step goals by occasionally taking off the monitor for a couple of days so it would automatically lower the step goals to a more achievable goal.

Because it's almost like, the-the goals are running y'life so I have to then take time out for it could be anything from a couple of days to a week, take the watch off. (Lisa)

However, Lisa felt "totally naked" without the monitor, indicating an important interdependent relationship. Lisa's contradictions, from being reliant on the monitor to taking it off for a week, indicate that even if her relationship with the watch changes, the watch continues to have a role in her activity and health management.

But I do feel totally naked without it and lost because it-it's sort of part-part of me, y'know, prob'ly sounds silly but, but that's how I feel about about it, it's me and everybody knows I mean I've never gone watches bracelet anything until I had this and this is permanently, erm on my arm. (Lisa)

The monitor was pivotal in changing participants' lives over time expressing a "before" to "now" where it had become integrated into their individual lives. However, they did not detail much of this journey or process. For example, Chris compared his life now with the watch to before he had his watch, where he did not do as much activity and was generally more sedentary. Nicola felt that the activity monitor had "dramatically changed [her] life", helping her manage her COPD and mental well-being and thereby feeling more positive. Initially, Nicola was afraid to use her Fitbit to monitor her activity, but when taking part in pulmonary rehabilitation, she felt more comfortable being active because someone was there with her and encouraged her to do more than she thought she could do, describing them as a "security blanket". Following pulmonary rehabilitation, Nicola started using her Fitbit again as she felt unable to do as much at home compared to with healthcare practitioner support and experienced panic attacks because of her fear of breathlessness. The Fitbit helped her to monitor her activity and see what she had done, giving her more confidence to be active at home, knowing she had done it before during pulmonary rehabilitation.

I realised I was panicking so and from there I thought no I can't panic, I've done it there [at pulmonary rehabilitation] and I managed to get up to this point so I worked until I got back up to that point, that many steps and that do you know what I mean and from there I sort of went into competition, a bit more, a bit more, a bit more. (Nicola)

Looking forwards, Mary believed there would be potential for health monitoring with her General Practitioner (GP), such as apps giving them information to reduce the number of visits; she called this "seamless care". Mary believed her respiratory nurse was aware she used a Fitbit as she told her regularly about doing 10,000 steps, which she was pleased with. However, Mary felt that the



nurse did not really factor the information into their advice or treatment.

I think my doctor is and the respiratory nurse are aware that I use a Fitbit because I tell them about regularly doing the 10,000 steps which they are very pleased about erm, but erm they don't actually factor that into what they are telling me and the treatment. They are just really delighted the improvement I've had. (Mary)

Chris shared his data and information with his consultants (via emailing screenshots). Chris' main reason for getting his watch was for specific health management features, like electrocardiograms (ECGs) and fall detection. He described it as "medical curiosity". The health data enabled Chris to manage his health at home rather than needing healthcare practitioner intervention (e.g., having to go to the doctor or be admitted to the hospital). Chris believed this was beneficial to reduce costs to the healthcare system.

All those things [heart rate and step counts] really help me decide what I can and can't do for the day really, and also if I need to see a doctor about an infection of some sort erm, because, with all this sort of stuff, I can actually work out what's going on with my body rather than having to book a doctor's appointment all the time and go and see what they say I can actually work some of it out myself. (Chris)

Participants found activity monitors valuable in aiding self-management of their health condition and looking after their health overall. Mary felt her watch had increased her health and fitness "far beyond" the pulmonary rehabilitation course, feeling better than she had in years.

But the main thing that I've got from using the wearables is that they help me to increase my fitness erm far beyond the PR [pulmonary rehabilitation] course and I feel much better than I've felt for years. (Mary)

Some participants were reassured by their health data. However, some also experienced anxiety and worry about what the watch was telling them. For example, Chris and Michael revealed initial concerns about how having constant access to health information may increase anxiety, "doing more harm than good".

I think that's just about it really, there's no negatives to it I don't think erm my mum was worried that I was going to keep checking it too often and that it was gonna to mess with my mind a bit, but if anything, it kind of reassures me rather than makes me worry. (Chris)

Michael did not think the watch helped his COPD as it did not measure his lung capacity or breathing; "all it does [is] it just tells me what exercise I'm doing". However, from using the watch and monitoring his activity, he felt exercise helped his lungs. He understood that his "body [was] getting used to the exercise regime" from observing his heart rate. Additionally, his coughing had "calmed down a little bit" during exercise.

When I first started with the exercises me heart rate was going up something like about 148–152 beats a minute but me body's getting used to it now so me heart rate is like down to about 130 when I'm exercising which is a lot better for me. (Michael)

All participants anticipated future use of their technology and, as technology advances, upgrading their devices to ones with additional features. Michael and Chris talked about continuing to monitor and keep track of their activity and health in the future, indicating that the device was an investment and a part of their everyday life. Chris looked forward to future upgrades of the technology which would include additional health monitoring features, such as oxygen level monitoring.

I'm actually going to upgrade it to the new series 6 later on this year because that's going to have erm an oxygen monitor on it as well so it'll be able to tell me how much oxygen I'm breathing, erm so rather than having to have one of them spirometer things on your finger your iWatch will tell you. (Chris)

For Nicola upgrading her monitor would mean additional costs, but an upgrade would also resolve current issues with her watch, such as a broken strap. She said the cost of replacing the watch strap was "extortionate" and a "major downside". She had already once replaced the strap, which was again broken (currently held together with tape). Additionally, upgrading and changing to a different brand of watch was problematic, because Fitbit held all of Nicola's data, which she would lose switching to another brand.

I don't know what the others are like but I find Fitbit have got all my details you know all my data and I don't wanna swap it over because I want to keep hold of all that data if I can because they also do like... other things like reaching this point if if you were to walk towards the moon you would reach this point or whatever um there's other little bits hidden away and it's like you you get a little badge off them for certain things. (Nicola)

## Discussion

This qualitative study explored the experiences of people with COPD using activity monitors in everyday life. Four Group Experiential Themes were developed using IPA from interviews with seven people with COPD. Activity monitors had become integrated into participants' lives and were valuable in supporting their health and COPD by increasing their knowledge and awareness of their activity. Objectively monitoring and recording activity enabled participants to see and make sense of their activity levels, set activity goals, and increase their motivation to be physically active.

Objective feedback on PA levels gave participants something tangible that they could "see" and "evidence" their progress over time, in line with previous research [12]. Supporting Bartlett et al. [24] and Simmich et al. [25], specific device features, such as notifications and competitions, motivated participants to be more active and achieve their goals. Participants in the current study set achievable and realistic goals, adjusting as needed to ease pressure and expectations. In previous research, goals were often set in partnership with pulmonary rehabilitation staff, but participants rarely updated their goals, reasoning they were recommended by the experts and participants wanted to keep them achievable [26]. The current findings highlight how goal setting is individual and that support may be needed for participants to set achievable and realistic goals facilitating ownership.

Some participants compared their goals and achievements to guidelines and recommendations of PA, like 10,000 steps per day or 150 minutes of MVPA per week. One participant, Hannah, believed she was physically active and broadly followed recommended PA guidelines and kept her daily goal at 10,000 steps. Currently, PA recommendations and guidelines (e.g., the World Health Organization) do not acknowledge objective measurements of activity, such as step counts. Further research is needed into how people with COPD understand and follow current PA guidelines to develop appropriate PA guidance. Additionally, clarity is required on how current guidelines and PA recommendations translate to when using activity monitors and setting goals which record steps and distance, move calories, exercise minutes and stand hours.

Competition and comparison were important and motivational to some participants helping them to keep active and meet their

goals, similar to research in other populations [27]. However, views on competition among people with COPD have been mixed [24, 25]. Within the context of group exercise classes, social competitions and comparison have been beneficial to motivate participants rather than 'give up' if they were alone [28, 29]. Two participants in this current study did not discuss engaging in data sharing or competitions indicating there may be other reasons for non-engagement, and that it might not be suitable for everyone.

Competitions and peer interaction may be a barrier to engagement in PR as individuals 'avoid peers in an attempt to deny their illness and return to normality' and social aspects can remind individuals of the progressive nature of COPD eliciting fear [30] (p. 8). In this study, Lisa expressed how engaging in competitions with other people without any health conditions or people at different stages of their disease seemed unfair, similar to Simmich et al. [25]. Although social elements have the potential to increase user engagement and consequently activity levels, it is not a 'one-size fits all approach' [27]. The effect of social elements alone is difficult to assess in multicomponent interventions, although these qualitative findings highlight it may be beneficial for some and not others. Further research with people with COPD is needed to understand the meaningfulness and effectiveness of competitions and social sharing of activity data.

Activity monitors became uniquely integrated into and an important part of participants' lives. They developed complex interdependent relationships of reliance, control and obedience with the monitor. Potentially adverse effects of activity monitoring, such as constantly checking data and temporary abandonment of technology to manage goals, were found in this study. Past research has found hypervigilance of PA data and continuous monitoring can increase health anxiety among people with COPD [31]. Nevertheless, some participants were able to overrule any concerns, pressure and obsessiveness experienced with the activity monitors. Participants integrated their monitor into their lives and demonstrate that the user's judgement is needed to understand the data and the effects the activity monitor is having on their physical and mental well-being. This judgement and ability to make personal decisions about activity monitors may occur over time, with experience, or with support. Factors influencing this knowledge and understanding may include education, health status, digital literacy [32], and self-awareness/self-compassion [33]. The current research highlights that the ability of people with COPD to make sense of their technology is useful for monitoring their activity and, more broadly, self-management of their health. Also, researchers aiming to use activity monitors need to be aware of the potential adverse effects of using the technology. Support and assistance with understanding and learning to use the technology may need to be provided to participants with COPD to ensure that the monitors do not negatively impact their mental or physical health and wellbeing.

Supporting previous research [34, 35], activity monitors can positively affect the lives of people with COPD and their illness perceiving benefits to health and well-being. The potential for wearables and monitoring activity levels to help people with COPD better understand and self-manage their condition has previously been recognised [31]. Real-time monitoring of activity and health measurements (e.g., activity, heart rate, oxygen) could allow people with COPD to better understand the relationship between their symptoms and triggers, so they can feel safer when engaging in activity [31]. Moreover, participants anticipated using their activity monitors in the future and expressed excitement towards future updates and upgrades with additional monitoring features, the potential for further monitoring, the recording of health data, and sharing data with healthcare practitioners. People with COPD perceived additional monitoring features, such as oxygen

saturation, heart rate, blood pressure, sleep, and coughing, could be beneficial to monitor additional aspects of their activity and health. This study supports Hawthorne et al. [36] who suggested activity monitors may also help patients with monitoring vital signs, such as heart rate, respiratory rate, and body temperature. Additionally, Wu et al. [31] noted devices that can monitor symptoms of COPD could help people to manage their health and feel safer engaging in PA. Furthermore, Huniche and colleagues [17] suggested people with COPD can understand and utilise PA data in various ways to manage their health condition. Further research is needed to explore the possibilities for monitoring vital signs remotely and continuously, to facilitate better self-management of COPD.

### **Strengths and limitations**

This is the first qualitative study to explore the in-depth experiences of people with COPD using activity monitors that have become integrated into everyday life. Participants in previous research have been interviewed early in their use of activity monitors [e.g., 2 weeks to 3 months; 26, 35, 37–41] which may mean they are at the beginning of their journey and process of understanding the monitor's features and functions. Negative experiences were rarely discussed suggesting participants may have become more accustomed to its functionality over time, displaying more contentment, understanding and appreciation for the device.

While this research highlights positive experiences of using the technology, it is important to note a potential sampling bias. Participants reported a manageable scale of breathlessness (i.e., MRC Grade 3 or below), most had completed PR, and were mainly recruited through social media suggesting a group of participants comfortable using technology and educated on the importance of physical activity. The sampling method, therefore, may inadvertently overlook insights into the barriers and challenges of integrating activity monitors into individuals lives who are less accustomed to using technology or choose not to. Demeyer and colleagues [42] reported patients with better exercise capacity and fewer symptoms of COPD had more favourable experiences with a PA intervention utilising a step counter and smartphone app than those with more symptoms. These findings suggest technological interventions may be more feasible and acceptable to people with earlier stages of COPD. Also, the current research did not explore the views and experiences of those who started and stopped using an activity monitor or never used one. Exploring the experiences of non-users, short-term users or at different stages of the usage journey may be helpful in further understanding barriers and facilitators to activity monitoring and how monitors can become fully integrated into their daily life. Nonetheless, this research provides important insights into the potential of activity monitors to support people with COPD and integrating technology into their daily lives for continuous monitoring and self-management.

### **Considerations around the context of obtaining data during the COVID-19 pandemic**

Two interviews were conducted early into the COVID-19 pandemic (May 2020 and June 2020), so participants' views and experiences of using technology may have changed considerably following guideline changes and vaccinations. This research did not intend to explore or understand the impact of COVID-19 on people with COPD, and due to the sensitivity of COVID-19 at the time, the researcher asked a few questions about it. Further research is needed to understand the impact of COVID-19 on people with COPD and how the use of technology and activity monitors has changed.

## Conclusion

This qualitative research enhances our understanding of the experiences of people with COPD using activity monitors in everyday life. People with COPD who integrate activity monitors into their lives had positive and negative experiences with the technology. Challenges of using activity monitors and potentially negative impacts on mental and physical health emphasise the need for support with technology use. Over time, they develop strategies to engage with the monitors successfully. There is potential for activity monitors to help people with COPD monitor and understand their activity levels and improve their health through effective self-management. The role of healthcare practitioners and other support available to people with COPD using activity monitors is yet to be explored but has the potential to address barriers to monitoring and facilitate the effective use of technology for self-management at home.

## Acknowledgements

The authors would like to acknowledge and thank the participants who took the time and effort to take part in this research and share their experiences.

## Authors' contributions

Laura Wilde: Conceptualization, Methodology, Validation, Formal analysis, Investigation, Resources, Data Curation, Writing - Original Draft, Writing - Review & Editing, Visualization, Project administration. Carol Percy: Conceptualization, Methodology, Validation, Writing - Review & Editing, Supervision. Cain Clark: Conceptualization, Methodology, Validation, Writing - Review & Editing, Supervision. Gillian Ward: Conceptualization, Methodology, Validation, Writing - Review & Editing, Supervision. Petra Wark: Conceptualization, Methodology, Validation, Writing - Review & Editing, Supervision. Louise Sewell: Conceptualization, Methodology, Validation, Writing - Review & Editing, Supervision.

## Disclosure statement

The authors report no conflicts of interest.

## Funding

LW's PhD studies (of which this study is a part of) was funded by the Centre for Intelligent Healthcare, Coventry University, UK

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## Data availability statement

The data supporting this study's findings are available on request from the corresponding author.

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