BMJ Open

Investigating the usefulness of Automated Check-in Data Collection in general practice (AC DC Study): a multicentre, cross-sectional study in England

Sarah Lawton ,[1,2] Christian Mallen,[1,3] Sara Muller,[1] Simon Wathall,[2] Toby Helliwell[1,3]

To cite: Lawton S, Mallen C, Muller S, *et al*. Investigating the usefulness of Automated Check-in Data Collection in general practice (AC DC Study): a multicentre, cross-sectional study in England. *BMJ Open* 2023;**13**:e062389. doi:10.1136/bmjopen-2022-062389

► Prepublication history for this paper is available online. To view these files, please visit the journal online (http://dx.doi.org/10.1136/bmjopen-2022-062389).

Received 08 March 2022
Accepted 20 October 2022

[1]School of Medicine, Keele University, Keele, UK
[2]Keele CTU, Keele University, Keele, Staffordshire, UK
[3]Midlands Partnership NHS Foundation Trust, Stafford, UK

Correspondence to
Sarah Lawton;
s.a.lawton@keele.ac.uk

ABSTRACT

Objectives To investigate the usefulness of using automated appointment check-in screens to collect brief research data from patients, prior to their general practice consultation.

Design A descriptive, cross-sectional study.

Setting Nine general practices in the West Midlands, UK. Recruitment commenced in Autumn 2018 and was concluded by 31 March 2019.

Participants All patients aged 18 years and above, self-completing an automated check-in screen prior to their general practice consultation, were invited to participate during a 3-week recruitment period.

Primary and secondary outcome measures The response rate to the use of the automated check-in screen as a research data collection tool was the primary outcome measure. Secondary outcomes included responses to the two research questions and an assessment of impact of check-in completion on general practice operationalisation

Results Over 85% (n=9274) of patients self-completing an automated check-in screen participated in the Automated Check-in Data Collection Study (61.0% (n=5653) women, mean age 55.1 years (range 18–98 years, SD=18.5)). 96.2% (n=8922) of participants answered a 'clinical' research question, reporting the degree of bodily pain experienced during the past 4 weeks: 32.9% (n=2937) experienced no pain, 28.1% (n=2507) very mild or mild pain and 39.0% (n=3478) moderate, severe or very severe pain. 89.3% (n=8285) of participants answered a 'non-clinical' research question on contact regarding future research studies: 46.9% (n=3889) of participants responded 'Yes, I'd be happy for you to contact me about research of relevance to me'.

Conclusions Using automated check-in facilities to integrate research into routine general practice is a potentially useful way to collect brief research data from patients. With the COVID-19 pandemic initiating an extensive digital transformation in society, now is an ideal time to build on these opportunities and investigate alternative, innovative ways to collect research data.

Trial registration number ISRCTN82531292.

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ The study investigates a cost-effective method for collecting brief research data rapidly from a significant number of participants.
⇒ The method investigated is an innovative contribution to research delivery that is integrated into routine general practice, is patient-centred and is enabled by digital tools.
⇒ The main limitation of this study is the limited amount of data we were able to collect.
⇒ The effectiveness of the data collection method could have been reduced by changes in consulting practices precipitated by the COVID-19 pandemic.

INTRODUCTION

Choosing the optimal way to collect research data is a predicament faced by many researchers.[1] When investigating health, and health services, there are a number of factors that need to be considered, depending on the research question. Data collection methods are most effective when triangulated with each other[2] or when a range of methods are used to optimise response rates and to reduce the potential for bias. While there is no agreed-upon minimum acceptable response rate when using self-completed data collection tools, parameters influencing response rates include: subject matter, delivery method, length, target audience and incentives. Recent research investigating this (2019) indicated an average survey response rate of 33%.[3]

With advancements in digital approaches over recent years in our everyday lives, for example, in banking, shopping and communications, knowledge gaps and apprehension around the use of newer or novel data collection methods are expected. The role

of Technology Enabled Care Services (TECS) have, however, gained increasing recognition.[4] The use of TECS supports the transformation of new models of care delivery and allows patients to meet their needs and preferences, together with the provision of efficiencies for general practice.

Prior to the emergence of COVID-19, when visiting a general practice for a clinical consultation, instead of patients needing to 'book in' with the receptionist, it had become commonplace for many general practices to host an automated check-in screen. In a time where primary care is underfunded,[5] the automated check-in screen is a cost-effective option that frees up receptionist time for other more complex tasks.[6] Patients independently approach the check-in screen and touch the screen to select successively their sex, and their day and month of birth, thus letting the practice know that they have arrived and are ready for their consultation. They then receive a confirmation of their appointment in seconds. Some check in modules also have the facility to collect brief additional data and add this to the patient's record.

As such, an investigation into the possibility of repurposing the function of the automated check-in screen for use as a research recruitment and data collection tool and a way of providing patients with the ability to take control of their choices is required. This study investigates the usefulness of check-in screens as a research tool to collect brief research data, while an automated check-in screen is completed prior to a general practice consultation. The subject and format of research questions can also impact on completion rates.[7] For this reason, this study included both a clinical research question on 'bodily pain' and a non-clinical research question on 'contact about research'.

METHODS

Study design

Ten general practices within the National Institute for Health and Care Research (NIHR) Clinical Research Network (CRN): West Midlands (WM), whose General Practice System of Choice (GPSoC) was Egton Medical Information Systems (EMIS) Health, were invited to host the 'Automated Check-in Data Collection Study' (AC DC Study). Participating general practices were required to have access to Egton Automated Arrival facilities to include a questionnaire module and an automated arrivals check-in touchscreen.

Participants

During the 3-week recruitment period, all patients 18 years and above, attending for a booked appointment and completing an automated check-in screen to confirm their attendance for their appointment, were eligible to participate. Once a patient had confirmed their attendance for a booked appointment, the research questions appeared for completion. Consent to participate was implied by question completion, in line with the definition outlined in Article 4 (11) of the General Data Protection Regulation guidance.[8] All practices collected data during the spring of 2019.

Data collection

In order to test the approach, two different research question domains were selected to assess willingness to participate and to maximise completion of responses; one 'clinical', on the level of bodily pain experienced during the past 4 weeks, and one 'non-clinical', asking whether patients would be happy to be contacted about future research studies of relevance to them. Responses were automatically filed back to the patients' electronic medical record. A series of pseudonymised data extractions were conducted by participating practices and securely transferred to the research team for analysis. Any check-in queries made to practice administration staff by patients as a result of the study were anonymously logged by the practice in an AC DC Study diary, to assess the impact of check-in completion on general practice operationalisation and workload.

Patient and public involvement

A Patient and Public Involvement and Engagement (PPIE) group was convened to assist designing and developing the study. The patient facing documentation was codeveloped with the PPIE group. They were asked to consider the patient facing documents in terms of content, layout, wording, style and length. The wording of the AC DC research questions, together with their associated options for completion and the order of the questions, was agreed by the group. The PPIE group agreed that the questions needed to be brief and easy to answer quickly. They were in agreement that asking two research questions would be appropriate as there would not be time for more than this. The process of data collection, confidentiality and time taken to complete were discussed. While this study was conducted before the emergence of the COVID-19 pandemic, hygiene was a concern for the group. The concerns, however, were considered proportional with others, including the opening of doors and holding onto railings, and so were considered acceptable. Recommendations for results dissemination were also provided.

Data analysis

Simple descriptive statistics were used to characterise the study sample and to compare potential demographic differences between responders and non-responders. IBM SPSS Statistics V.24[9] was the statistical software used to analyse the data. In the production of and reporting on subgroups (practice, age group, gender), Office for National Statistics (ONS) guidance were followed on statistical microdata to ensure the confidentiality of individual persons was protected.[10]

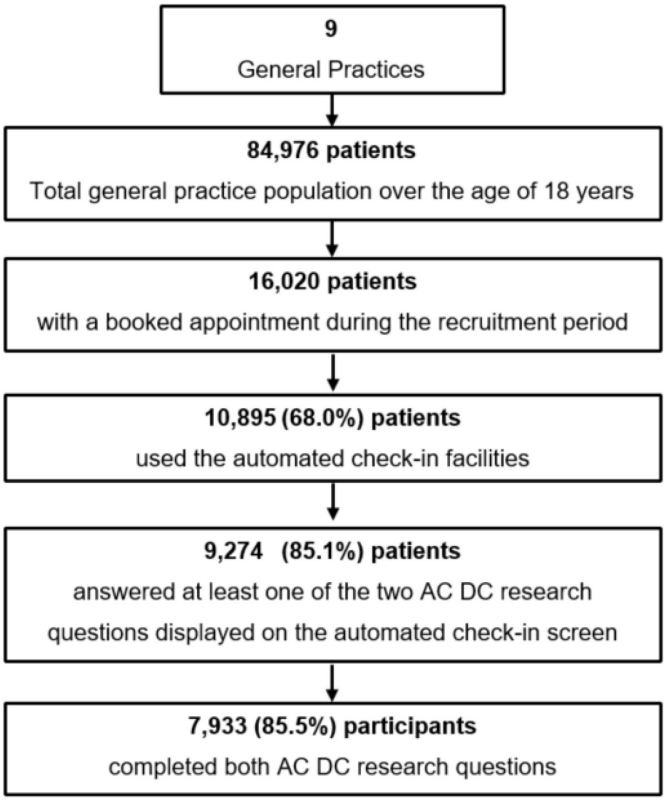

Figure 1 Summary of Automated Check-in Data Collection (AC DC) Study participants.

RESULTS

A total of 9 general practices, with a total population of 84 976 patients aged 18 years of age or over, hosted the study during Spring 2019. The last practice completed data collection on 31 March 2019. Of potentially eligible participants with booked consultations (n=16 020), 10 895 (68.0%) checked themselves in for their appointment using the automated check-in screen and thus were shown the first research question. Participants completing the check-in screen, were similar to the overall patient population with a booked appointment during the recruitment period (60.3% female vs 61.5% female; mean (SD) age 55.2 (18.7) years vs aged 56.8 (19.2) years). A total of 9274 participants (85.1%) completed at least one research question (figure 1).

Baseline demographics of participants versus non-participants are summarised in table 1.

During recruitment, ongoing data monitoring identified that one practice had a spuriously low participation rate. Following investigation, an error was identified in the 'question display time' setting on the automated check-in screen at this practice. The 'question display time' setting was 10 s, rather than the 30 s as dictated within the practice set-up instructions. Removing this practice from analyses as an outlier, provides a participation rate of 89.2%.

Table 1 Demographics of study participants and non-participants (n=10 895)

	Participants, n=9274 (85.1%)	Non-participants, n=1621 (14.9%)
Age (years, mean (SD))	55.1 (18.5)	55.7 (20.0)
Female gender (n(%))	5635 (61.0%)	1050 (64.8%)

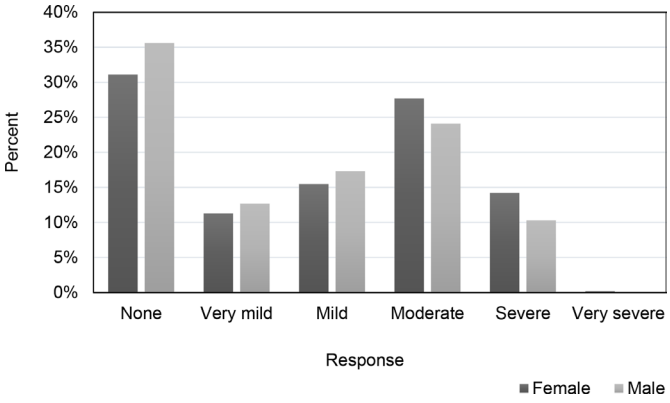

Figure 2 Bodily pain reported during the past 4 weeks.

AC DC research question responses

Overall, 85.5% (7933) of participants completed both AC DC research questions. There were no significant differences when the data were stratified by practice or by gender.

Overall, 96.2% (8922) of participants answered the 'clinical' research question, 'How much bodily pain have you had during the past 4 weeks?'. Response options provided included, 'none', 'very mild', 'mild', 'moderate', 'severe', 'very severe' or 'skip question'. The distribution of responses did not vary by age; however, females reported higher levels of moderate (27.7%), severe (14.2%) and very severe (0.2%) bodily pain than males (moderate (24.1%), severe (10.3%) and very severe (0.0%)), although this was not statistically significant (95% CI: 3.32 to 3.37; p=0.1096; figure 2).

Overall, 89.3% (8285) of participants answered the 'non-clinical' research question, 'Would you be happy for your practice to contact you about any future research studies which are relevant to your health, to improve care for patients in the NHS?'. Responses provided included, 'Yes, I'd be happy for you to contact me about research of relevance to me', 'No, thank you' or 'Skip question'. Overall, 46.9% (3889) of participants responded, 'Yes, I'd be happy for you to contact me about research of relevance to me', see table 2.

Responses varied little by practice or gender, although patients in the youngest and eldest age groups responded, 'Yes, I'd be happy for you to contact me about research of relevance to me' least.

Practice operationalisation

The AC DC Study generated a total of three 'observations' from nine general practice AC DC Study diaries. These were: (1) 'Questions are looping, not allowing check-in', which was a short-term system functionality error. It was reported that this had been resolved 7 min later; (2) 'Patient wishes to change their mind to the

Table 2 Response to the 'contact me about research of relevance to me' question

	Response to the 'non-clinical' research question		'Yes, I'd be happy for you to contact me about research of relevance to me'	
	%	(n)	%	(n)
Practice				
1	88.8%	(976)	48.6%	(474)
2	90.8%	(996)	46.3%	(461)
3	84.9%	(767)	51.6%	(396)
4	90.6%	(823)	43.6%	(359)
5	90.6%	(336)	50.6%	(170)
6	89.0%	(2082)	46.4%	(966)
7	82.3%	(583)	48.2%	(281)
8	96.2%	(1041)	46.6%	(485)
9	88.8%	(681)	43.6%	(297)
Totals	89.3%	(8285)	46.9%	(3889)
Age group				
18–34	97.6%	(1531)	39.6%	(607)
35–49	97.1%	(1715)	48.6%	(834)
50–64	93.8%	(2249)	50.2%	(1128)
65–79	89.4%	(2109)	49.8%	(1051)
80+	84.0%	(681)	39.5%	(269)
Totals	89.3%	(8285)	46.9%	(3889)
Gender				
Female	89.4%	(5054)	47.0%	(2374)
Male	89.2%	(3231)	46.9%	(1515)
Totals	89.3%	(8285)	46.9%	(3889)

second question, EMIS updated', practice staff were able to update response; and (3) 'Check-in screen not finding patients', this was due to the patient not actually having a booked appointment. The general practice operational disruption caused as a result of the AC DC Study could therefore be considered negligible.

DISCUSSION

This study provides evidence that automated check-in screens used in general practice settings can be used to collect brief research data from patients prior to their general practice appointment. Of those patients that used the check-in screen, over 85.1% participated in the study. Use of this method to collect brief research data has exceeded previously described published survey data collection methodology average response rates[3]; however, these results must be interpreted with caution.

Advantages of the AC DC methodology

The use of a check-in screen to collect brief research data represents a cost-effective (where technological infrastructure already exists), convenient and precise opportunity to collect research data rapidly from significant numbers of participants. The method could also be used for prescreening potential participants, for later invitation to a larger research study. The technology enables geographical and population specific sampling and minimises sampling bias. Information and confounding biases are also minimised, with the entirely automated delivery of the study ensuring that delivery remained consistent. The ability to monitor data collected in a live environment also enabled rapid resolution of any data collection problems. For example, the incorrect check-in screen setting that caused one practice to have a spuriously low participation rate was identified, and the issue rectified immediately remotely. By using this methodology, there was no disruption to practice operationalisation, providing an efficient way to embed research into a healthcare setting. There was also a contribution to the pending consultation, its subsequent impact on the delivery of clinical care however requires further research.

Disadvantages of the AC DC methodology

The main disadvantage of the methodology is that of its brevity. Only a limited amount of data can be collected, with an inability to gauge salience and context of responses. Overall, 32.0% of patients did not check-in using the automated screen, possibly highlighting some selection bias. Although the age and gender distributions of all patients and those using the screens were similar, these patients may have needed to speak to the receptionist about other matters, had visual impairments, language barriers or were too unwell.

The number of responses must also be restricted, otherwise not all response options are visible on the automated check-in screen at the same time and therefore may not be used. Only 0.1% of participants answering the bodily pain question, reported 'very severe' pain. This may reflect a true prevalence in the population studied; however, without touching the screen and scrolling down, participants would not have seen the 'very severe' response option. For future use, where multiple choice responses are provided, the entire balanced scale of responses must be visible, with a limit of five response options recommended.

Only those general practices whose GPSoC was EMIS Health participated. EMIS Health is used by 67% of practices across the CRN WM footprint[11] and the customisable options it offers provided the opportunity to deliver this study. Further investigation into the operational ability of other GPSoC is required for the conduct of future research using the AC DC methodology.

Research question findings

The Royal College of General Practitioners report that chronic pain is a presenting condition in around 22% of primary care consultations.[12] AC DC Study participants may not have been consulting for pain; however, the study identified that moderate/severe/very severe bodily pain over the last 4 weeks, was reported by 39.0% of participants (42.0% females and 34.4% males), which was higher than the reporting of no bodily pain over the

last 4 weeks, reported by 32.9% of participants. Patient experience of pain in a consulting population appears to be high and warrants further research.

Overall, 46.9% confirmed that they would be happy to be contacted about research of relevance. There was very little variation by practice or by gender in response; however, age was a factor in response to this question, with less than 40% of participants in the age groups 18–34 years and 80+ years confirming that, yes, they would be happy to be contacted about research of relevance. Stigma and normalisation could explain these responses. Those in the youngest age group may wish to remove themselves from being characterised by any involvement in health research. Those in the oldest age group may be normalising their current condition as a coping strategy, they do not consider as worthy of research.[13]

Much of the existing literature in this area concentrates on a willingness to participate in research, the AC DC Study has only investigated willingness to be contacted about research of relevance, which could be considered, the stage before participation. Government initiatives are continuously encouraging patient participation in health research. The NIHR promote a campaign entitled, 'I want to take part in a research study', to provide easy access to research for patients.[14] In just over 8 months, 637 379 participants from across the UK took part in public health research investigating the effects of, and treatment for, COVID-19. The UK government has now described the willingness of the UK public to participate in COVID-19 research as, 'inspiring'.[15] This may indicate that public willingness to participate in research has improved. An update on our understanding of public willingness to participate in research, particularly in the youngest and oldest groups post pandemic, will now be explored further by Keele Clinical Trials Unit.

Usefulness of the AC DC methodology

The AC DC methodology recruited, engaged and collected data from almost 10 000 patients in 3 weeks, with no impact on general practice operationalisation. The methodology is ideal for capturing very brief participant reported outcome measures at the point of care, or for use in sampling, to screen patients, perhaps for inclusion in a more detailed study later.

There is potential that the use of this technology can be developed further, in order to deliver more complex studies, using embedded logic dependant on responses provided. Search criteria could also be applied to provide selective sampling.

Exploring the clinical impact of the AC DC methodology was beyond the scope of the AC DC Study. However, this method of data collection embeds research entirely into clinical practice as data entered by participants is documented in their electronic health record which can be incorporated into their consultation and represents an opportunity for research to have immediate impact on patient care and outcomes.

Women are more likely than men to consult a general practitioner,[16] with 61.0% of general practice consultations made by women.[17] The AC DC Study concurs with this, reflecting established consulter demographic norms, providing no evidence of gender bias in participation. Acceptability of the methodology could therefore be implied, based on the high response rates obtained and the minimal impact on general practice operationalisation incurred. Further qualitative work to support the quantitative data collected and provide a robust conclusion on acceptability, however, would be required.

This study has demonstrated that integrating research into routine practice with use of the AC DC methodology is an effective way to collect brief research data. As COVID-19 restrictions reduce and patients return to the general practice, check-in screens will again be used to ensure that both check-in is completed and additionally that face-to-face contact is minimised. As previously described, developments in the use of check-in screens to identify and screen potential participants for research, together with the collection of brief research data, could resume. Overall, 68% of patients engaged with the check-in facilities prior to the pandemic. Following the pandemic, it is expected that effectiveness of the methodology will only increase, in line with the increased uptake in the use of digital technology by patients we have observed over the past 2 years.[18]

CONCLUSION

Designing a data collection methodology for research that could provide 100% participation would be a revolutionary achievement. Until then, and especially with the COVID-19 pandemic initiating an extensive digital transformation in society, now is an ideal time to investigate other ways in which electronic research data can be captured quickly and efficiently, minus the resistance or inertia which we may have previously encountered. In March 2021, the UK Government set out 'The Future of UK Clinical Research Delivery'.[19] This vision outlines an aim, to ensure that 'streamlined, efficient and innovative research' is embedded within the NHS. Requirements of the vision include delivery of research that is patient centred and enabled by digital tools. The AC DC Study and its findings provide a significant contribution to the developments within this field.

Acknowledgements The authors would like to thank the nine participating general practices within National Institute for Health and Care Research Clinical Research Network West Midlands.

Contributors The guarantor accepting full responsibility for this work, for the conduct of the study and for the decision to publish was SL. SL, CM, SM, SW and TH designed the study. SL and SW collected the data. SL and SM conducted the analysis. SL wrote the first draft of the manuscript. All authors contributed to subsequent drafts and read and approved the final manuscript.

Funding This work was supported by the Medical School, Keele University. CM and SM are partly funded by the National Institute for Health and Care Research (NIHR) Applied Research Collaboration West Midlands. CM is partly funded by the NIHR School for Primary Care Research. The views expressed are those of the authors and not necessarily those of the NIHR or the Department of Health and Social Care.

Competing interests None declared.

Patient and public involvement Patients and/or the public were involved in the design, or conduct, or reporting, or dissemination plans of this research. Refer to the Methods section for further details.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants. Ethics approval was provided by: London—Westminster Research Ethics Committee Reference: 18/LO/1506. Participants gave informed consent to participate in the study before taking part.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available upon reasonable request. Keele University is a member of the UK Reproducibility Network and committed to the principles of the UK Concordat on Open Research Data. The School of Medicine and Keele Clinical Trials Unit make data available to bona-fide researchers upon reasonable request via open or restricted access through a strict controlled access procedure. In the first instance, data requests and enquiries should be directed to medicine.datasharing@keele.ac.uk.

ORCID iD

Sarah Lawton http://orcid.org/0000-0002-8909-2057

REFERENCES

1 Paradis E, O'Brien B, Nimmon L, *et al*. Design: selection of data collection methods. *J Grad Med Educ* 2016;8:263–4.
2 Moon MD. Triangulation: a method to increase validity, reliability, and Legitimation in clinical research. *J Emerg Nurs* 2019;45:103–5.
3 Lindemann N. Survey Anyplace, 2019. Available: https://surveyanyplace.com/average-survey-response-rate/ [Accessed 10 Oct 2019].
4 Chambers R. *Code of practice for technology enabled care services for Staffordshire local digital roadmap*. UK: Staffordshire Digital Design Authority (SDDA), 2017.
5 NHS. *General practice forward view*. UK: NHS England, 2016.
6 Williamson C. Electronic self check-in for patients: the costs and consequences. *Br J Gen Pract* 2016;66:145.
7 Newington L, Metcalfe A. Factors influencing recruitment to research: qualitative study of the experiences and perceptions of research teams. *BMC Med Res Methodol* 2014;14:10.
8 Parliament E. *Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (GDPR*. Official Journal of the European Union, 2016: 1–119.
9 IBM CR. *Ibm SPSS statistics for windows, version 24.0*. Armonk, NY: IBM Corp, 2016.
10 Office for Statistics Regulation. *Code of practice for statistics*. Edition 2.0, 2018.
11 Kontopantelis E, Stevens RJ, Helms PJ. Spatial distribution of clinical computer systems in England in 131 2016 and implications for primary care electronic medical record databases. *BMJ Open*;8.
12 RCGP. Chronic pain. retrieved from Royal College of general practitioners. Available: https://www.rcgp.org.uk/clinical-and-research/resources/a-to-z-clinical-resources/chronic-pain.aspx [Accessed 13 Jan 2021].
13 Thompson L, Dowell A, Hilder J. *How do patients and general practitioners talk about pain and negotiate empathy in consultations? a direct observational study*. Wiley Health and Social care in the community, 2021: 1–10.
14 National Institute for Health Research. I want to take part in a research study. retrieved from National Institute for health research. Available: https://www.nihr.ac.uk/patients-carers-and-the-public/i-want-to-take-part-in-a-study.htm [Accessed 01 Dec 2020].
15 UK Government. GOV.UK. retrieved from over half a million people taking part in pioneering COVID-19 research. Available: https://www.gov.uk/government/news/over-half-a-million-people-taking-part-in-pioneering-covid-19-research [Accessed 05 Dec 2020].
16 Eurostat. Healthcare activities statistics - consultations. Retrieved from Statistics Explained, 2020. Available: https://ec.europa.eu/eurostat/statistics-explained/index.php/Healthcare_activities_statistics_-_consultations
17 NHS Digital. Appointments in general practice December 2019. retrieved from NHS digital:. Available: https://digital.nhs.uk/data-and-information/publications/statistical/appointments-in-general-practice/december-2019 [Accessed 31 Dec 2019].
18 Hutchings R. The impact of Covid-19 on the use of digital technology in the NHS. Nuffield trust, 2020. Available: https://www.nuffieldtrust.org.uk/files/2020-08/the-impact-of-covid-19-on-the-use-of-digital-technology-in-the-nhs-web-2.pdf
19 Department of Health & Social Care. The future of UK clinical research delivery. retrieved December 18, 2021, from saving and improving lives: the future of UK clinical research delivery, 2021. Available: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/995768/The-future-of-UK-clinical-research-delivery.pdf [Accessed 18 Dec 2021].