Supplementary file 4 – Summary of implementation findings

Table 1. Summary of key findings relating to how COVID-19 remote home monitoring services was implemented across the 28 sites included in our evaluation

Stage	**Summary of key findings** (from staff and patient surveys and interviews)
Entry criteria	**Age** • There was variability in the age entry criteria used across services (65+ n=1, 18+ n=13, 50+ n=11, did not use age n=3). • Many sites adapted and reduced their enrolment age throughout the period. **Risk factors** • Most services (n=25/28) enrolled patients based on specified risk factors (e.g. extremely clinically vulnerable, COPD, learning disabilities). • There was variation across sites in risk factors used to enrol patients (e.g. some used severe mental illness or learning disability as a criteria, whereas others did not).

Staffing and oversight	**Responsibility for service:**
	• Variability in which sector held responsibility for the service (n=15 primary care/community care, n=5 secondary care, n=6 primary and secondary care, n=2 did not specify).
	Number of staff
	• Large variability in number of staff involved in setting up and running service:
	  ○ Setting up the service: Ranged from 2-20+ staff setting up the service. Majority of sites had between 2-5 staff setting up services (n=11) or 6-10 staff (n=9).
	  ○ Running the service: Ranged from 2-70+ staff running the service. Majority of staff had 6-10 staff running the service (n=14).
	Type of staff
	• Differences in the type of staff across services (n=15 clinical, n=10 clinical and administrative, n=3 did not specify).

Referral	• Many referral methods were used by our sites (as reported in at least one data source):
	  ○ GP (n=23 sites).
	  ○ Community clinics/hot hubs (n=23).
	  ○ Hospital EDs (n=25).
	  ○ Hospital early discharge (n=22).

	○ 111 (n=14). ○ COVID clinical assessment (n=9). ○ Test and Trace (n=11). ○ Care homes (n=7). ○ Other (n=22).
Triage	• Most sites had triage processes in place (n=24/25, 96%). One service did not report having triage processes in place. • Staff interview findings indicated that assessment processes varied across different models. Seven of the case study services reported that patients were checked against admission criteria (e.g. by administrators, call handlers, GP practices, care companies, GPs, advanced nurse practitioners, clinical staff). Additionally, one service spoke about having a drive-through assessment service using tents and an indoor consultation area. Some services reported having a risk stratification element to the referral and assessment process (n=4), e.g. colour coding or developing different caseloads based on severity.
Onboarding	**Oximeter provision** • All service leads reported that their service provided patients with oximeters. • However, an average of 94.2% (range: 75-100%) of patients reported receiving oximeters. • The distribution of oximeters varied across service models. Sites often used multiple methods to provide oximeters, including delivery by healthcare/voluntary sector (n=27 sites), and giving oximeters at GP/hospital (n=9 sites). Seven sites asked patients/family to collect oximeter. • Some patients/carers used or bought their own oximeters. • Some interview participants spoke about how experiencing difficulties collecting the oximeter (as they were too poorly, it was too far away, they were unable to travel or didn't have anyone to collect it for them). **Information provision** • Most service leads (88%, n=22/25) reported that their service provided patients with information. • Most patients reported receiving information on using the oximeter (95.1%, range: 75-100%), taking and recording readings (94.4%, range: 75-100%), and what to do if oxygen levels dropped below recommended threshold (93.6%, range: 80-100%). • Findings from interviews and surveys indicated that services provided different types of information (written, verbal, online information). • The type of information that patients reported receiving varied, including: written information (57.2%, range: 14.3-86.5%), telephone information (49.7%, range: 11.6-79.2%), online information (3.3%, range: 0-13%) and other types

	of information such as face-to-face (16%, range: 0-62.5%). • Some interview participants reported receiving no information and some survey respondents were not aware of what the service is, why they had been referred or what it would involve.
Monitoring	**Monitoring** • All of the services reported that the model involved patient monitoring. • Nearly all patients reported taking readings using the oximeter (94.9%, range: 81-100%). • Models range from being digitally enabled with non-automated telephone calls (1x a day or less) if digital not possible (n=11), to models which are telephone enabled but also offer face-to-face monitoring appointments when needed (n=2). • Members of staff were involved in taking/reporting readings at all sites. • None of the services solely used patient self-monitoring. **Type of monitoring option offered** • Eighteen services reported using paper and telephone (i.e. analogue); 63% (range: 5.6-100%) of patients reported being asked to record using paper and telephone. • Twenty-one services reported using digital methods; 41% (range: 0-97.2%) of patients reported using digital methods, including apps, text and emails. **Frequency of monitoring and level of interaction with staff** • Findings from all data sources indicated that the frequency of monitoring (taking and submitting readings) and frequency of contact with staff varies. • For example, interview findings highlighted that submission of readings ranged from once a day to four times a day. • Additionally, patient survey findings demonstrated that frequency of speaking with members of staff varied from several times a day (15.9%, range: 0-44.7%), to not at all (6%, range: 0-27.3%). The most common amount of times to speak to staff was once a day (26%, range: 6.7%-90.9%) or several times a week (25.5%, range: 0-62.2%). • Findings from the staff survey indicated that there was quite a bit of tailoring of monitoring processes to patient needs and preferences (e.g. changing the mode of monitoring, frequency or providing extra support). **Escalation processes** • Findings from staff interviews indicated six types of escalation processes, including: ○ Automated escalation processes (n=1 escalated straight away, n=2 phone assessment as needed, n=2 phone/face-to-face assessment as needed).

	○ Manually initiated escalation processes (n=3 escalated straight away, n=2 phone assessment as needed, n=4 phone/face-to-face assessment as needed). • Less than a third of survey participants (patients/carers) reported that they were asked to check over their readings for issues (20.1%, 7.3-40.5%) or seek further help due to readings being lower than recommended thresholds (32.2%, range: 18.2-71.4%). • Most patients reported that they stayed at home for the duration of the service (82.3%, range: 54.5-92.4%). Some patients were asked to attend the ED (9.3%, range: 0-45.5%) or admitted to hospital (11.4%, range: 0-45.5).
Recovery and discharge	**Discharge processes** • Nineteen clinical leads/service managers (76%) reported that their service included patient discharge. • Many services signposted to patients' GP (n=25/25) or community care services (n=11/25). • Most of the case study services reported that patients were discharged after 14 days. However, in the interviews, some staff and patients spoke about flexibility surrounding discharge (e.g. if patients didn't want to stay on the service for 14 days and were feeling better could be discharged earlier, or if patients needed to stay on for longer due to still not feeling well or reassurance). **Patient understanding of discharge** • On average, 73.4% (n=769) of respondents to the patient survey reported understanding what would happen after being discharged from the service (range: 33.3%-90.9%). • This was supported by patient/carer interview findings which indicated that some participants had a good understanding but that not everyone knew what would happen or where to go for further support. **Oximeter return** • Most of the patients reported being asked to return the oximeter (68.7%, (n=701: range: 21.5%-100). • However, many survey and interview respondents highlighted frustrations relating to not knowing how to return their oximeter.

Table 2. Factors influencing local implementation of services

Influences on implementation		Definition	Areas of impact on SOP
1. Patient factors	1.1 Patient demographics and disease profile	The degree to which sites shaped the delivery of the programme to meet the specific needs of the local population influenced by factors such as socio-economic status, ethnic and cultural background, and prevalence of co-morbidities.	***Referral, Onboarding, Monitoring***
	1.2 Digital access and literacy	The ability of patients to access digital services (via a reliable internet connection) or otherwise the ability of patients to use digital technologies.	***Monitoring***
	1.3 Patient engagement	The degree of engagement with the service dependent upon the level of health literacy and willingness to comply.	***Onboarding, Monitoring***
2. Staff factors	2.1 Training, skill-set	The knowledge, skills, and experience necessary to deliver the service including signposting.	***Triage, Onboarding, Monitoring***
	2.2 Work environment	Whether staff were working from home or within a shared office space.	***All***
	2.3 Workload	The expected amount of work performed by the staff providing the service during their paid hours.	***Triage, Onboarding, Monitoring, Discharge***
3. Organisational factors	3.1 Staffing models	The mix of multi-disciplinary clinical and non-clinical staff, shift patterns and lines of reporting.	***All***
	3.2 Cross-organisation collaboration	Collaboration between organisations including between national bodies and local sites and across organisations within a single CO@h or CVW service.	***Referral, All***
	3.3 Learning environment	The culture and work practices that supported the learning of individuals and/or the organisation. [93]	***All***
	3.4 Engagement of senior management	The degree of engagement of senior staff in changing practice and supporting innovative delivery. [247]	***All***
4. Resources	4.1 Staff availability	The number of appropriately qualified staff available to deliver the service.	***All***
	4.2 Hardware	Availability of reliable pulse oximeters and digital devices.	***Monitoring, Onboarding***
	4.3 Software	The availability and functionality of the software used to support the service.	***Monitoring, Onboarding, Discharge***

Table 3. Models of tech-enabled and analogue-only remote home monitoring for COVID-19

Model of service (Site IDs)	**Options for how patients can submit readings** Underline indicates most frequently used mode of patient data submission	**Human contact during monitoring**	**No. of tech platforms providing model**
Tech-enabled and analogue: Universal (Sites E, I, P-A)	• **App** for patients that can use tech. • **Human phone calls** from the service for patients that cannot use tech-e.	• Call (or video call for Site I) from clinician if patient flags red or amber based on data submission. • Call from clinician (Sites E, I) or an administrator (Site P-A) if patient does not submit readings. • Once daily (Sites E, P-A) or twice daily (Site I) phone calls from clinician for patients that use analogue submission.[a] • In Site E, the tech provider gave the service tablet devices to distribute to patients, provided a collection service, and offered a support helpline to assist patients with technical queries about using the platforms, staffed by non-clinicians.	3
Tech-enabled and analogue: Universal (Site A)	• **Web link** by text or email for patients that can use their own smartphone, tablet or computer. • **App** for patients that are provided with a tablet by the tech provider. • **Human phone calls** from the tech provider for patients that cannot use tech-e.	• Call from clinician if patient flags red or amber based on data submission. • Call from tech provider if patient does not submit readings. • Twice a day phone calls from tech provider for patients that use analogue submission. • The tech provider onboarded patients to the service and called patients that did not submit readings, delivered and collected tablet devices to and from patients' home, and offered a support helpline to assist patients with technical queries about using the platforms, staffed by non-clinicians.	1
Tech-enabled and analogue: Universal (Sites B, C, G, J, M, N)	• **Web link** by text or email • **Automated phone calls** for patients who cannot use web links (option not used by Site J). • **Human phone calls** from the service for patients that cannot use tech-e.	• Call from clinician if patient flags red or amber based on data submission. • Call from a clinician (Sites B, G, J) or an administrator (Site C) if patient does not submit readings. • Patients called once (Sites B, G, J) or twice daily (Site M) by a clinician, or three times a day phone calls from an administrator (Site C) for patients that use analogue submission, or on days 2, 5, 6, 12 and 14 by a health care assistant (Site N).	1

Tech-enabled and analogue: Risk-stratified (Sites L, P-B)	• **App** for patients that can use tech. • **Human phone calls** from the service for patients that cannot use tech-e.	• Call from clinician if patient flags red or amber based on data submission or if patient does not submit readings. • For Site L, high-risk patients called on day 1, 3, 5, 7, 10, 14 by a senior clinician, and low-risk patients called on day 1, 7 and 14 by clinician. Risk assessed based on patient's medical history. • For Site P-B, high-risk analogue patients called once daily, and low-risk analogue patients called once every two days. Risk assessed based on the severity of COVID symptoms.	1
Tech-enabled and analogue: Risk-stratified (Site O)	• **App** for low-, medium-, or high-risk patients. • **Human phone calls** from the service for medium- or high-risk patients that cannot use tech-e. • **Self-monitoring** with safety netting info for low-risk patients who cannot use tech-e.	• Call from clinician if patient deteriorates based on data submission or does not submit readings. • Once a day phone call from clinician for high-risk patients. Risk assessed based on the presence of co-morbidities, patient's age, severity of COVID symptoms, and other factors associated with COVID infection and mortality such as patients with learning difficulties or in sheltered accommodation. • Three times a week phone call for medium-risk patients (day 2, 5, 7, 9, 12 and 14). • Once a week phone call for low–risk patients (day 7 and 14).	1
Tech-enabled and analogue: Risk-stratified (Site D)	• **Automated texts** for high- or medium-risk patients. • **App** for high-risk patients. • **Human phone calls** from the service for high-risk patients that cannot use tech-e. • **Self-monitoring** with safety netting info for low- or medium-risk patients that cannot use tech-e.	• Call from nurse if patient flags red or amber based on data submission. • Call from health care assistant (HCA) if patient does not submit readings. • Risk assessed based on the presence of co-morbidities and patient's age. • Daily phone calls from HCA for high risk patients that use analogue submission. • Once a week for low- and medium-risk patients (day 7 and 14).	1
Analogue-only: Universal (Site H)	• **Human phone calls** from the service for all patients.	• Patients are called once daily by a clinician.	n/a

Analogue-only: Risk-stratified (Sites F, K)	• **Human phone calls** from the service for most patients. • **Face-to-face visits** for patients who are struggling taking readings (e.g. because they are very unwell, have visual or cognitive impairment).	• In Site F, patients called once or twice a day or on alternative days by a clinician depending on their preferences and ability to monitor and understand escalation. More frequent monitoring days 5 to 10. The frequency of telephone calls was determined based on patients' medical history, ability to monitor their saturations and understanding of the escalation process, as well as patient preferences. • In Site K, CO@h patients are called three times a week by a clinician (day 2, 5, 7, 10, 12, 14). Higher-risk patients monitored daily by phone or seen face-to-face. Patients discharged from hospital were called more frequently than those referred from primary care and took into account patient preferences.	n/a

[a] Three times a day for patients weaning off oxygen at home (Site E).

Description of the submission process for patients using each tech-enabled mode

App	• Download app to smartphone or tablet. • Login in with username and password. • SMS text or notification to submit reading at the same time each day (optional - not used by all services). • Patient opens app and submits readings.
Web link by text or email	• Patient receives text message or email with a web link at the same times each day (web links are time-sensitive and cannot be reused). • Patient logs in with username and password or DOB. • Patient submits readings. • Optional steps: Patient receives confirmation of data entry. Patient is asked to retake readings. Patient is asked to escalate care.
Automated phone calls	• Patient receives phone call at the same time each day. • Automated voice confirms patient is answering and that it is ok to speak. • Automated voice talks patient through entering each reading in turn.
Automated texts	• Patient receives a text each day asking them to reply with their oxygen saturation reading. • Patient receives a confirmation text that their reading has been submitted and is advised to call 111 or 999 if they have concerns.