

Understanding the Technology-Mediated Home Phlebotomy Ecosystem in India

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The increasing platformization of healthcare services in India, in the wake of COVID-19, has resulted in huge demand for home phlebotomy. However, there is a limited understanding of the impact of digitization on home phlebotomists' workflows. To address this gap, we conducted 26 semi-structured interviews with home phlebotomists, riders, and patients, supplemented by observations of the entire workday of 3 phlebotomists. We found that home phlebotomists' technology-mediated workflows are organized in ways that enable them to build strong support networks of human infrastructure, helping them negotiate and optimize their daily workflows. Moreover, while digitization of their workflows resulted in continued surveillance, it empowered them to justify their decisions and present evidence of work when needed. Based on our findings, we discuss implications for equitable platform work and future of platformized health, and conclude with design recommendations for telehealth platforms offering home phlebotomy services.

CCS Concepts: • **Human-centered computing** → **Human computer interaction (HCI)**; **Empirical studies in HCI**; **Field studies**.

Additional Key Words and Phrases: healthcare, phlebotomy, telemedicine, platformization, gig-worker

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1 INTRODUCTION

The penetration of technology in every aspect of our lives has been on an exponential rise, especially in developing countries like India [16, 29]. The increased access and ubiquitous presence of technology has led to rapid digitization of essential services ranging from food delivery to cab aggregation, giving rise to on-demand digital platforms (such as Uber, Zomato, and Urban Company). A recent example of digitization in India is found in the healthcare sector, where there has been an emergence of digital platforms offering on-demand telehealth services including teleconsultation, medicine delivery, and home diagnostic tests. In particular, during the COVID-19 pandemic, patients were reluctant to physically visit the diagnostic labs because of the fear of contracting the disease [54], which resulted in a spike in demand for home phlebotomy services. This led to private enterprises including aggregator health platforms (like Tata 1mg, PharmEasy) and diagnostic labs (like Dr Lal PathLabs, SRL Diagnostics) offering digital solutions to facilitate online booking of home phlebotomy services resulting in digitization of phlebotomists' workflows.

Home Phlebotomists are healthcare professionals responsible for collecting bodily fluid samples (such as blood, urine, and saliva) at the patient's house for diagnostic testing purposes. It is important to study how has digitization shaped and impacted their routine workflows, to develop better technologies for them. Additionally, since home phlebotomists are the only medically-trained healthcare professionals visiting the patient's house, there is immense scope to exploit them for last mile delivery of healthcare, *e.g.*, as intermediary to support teleconsultations [4, 8]. Current telemedicine technologies are limited to phone (audio/video) calls and lack physical examinations. In future, home phlebotomists can capture and share videos required for physical examinations with remote doctors to enable an

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53 improved, intermediated telemedicine experience for patients and doctors [4]. Hence, it is essential to understand the
54 roles, responsibilities, workflows, technology usage, and challenges faced by home phlebotomists, who are a crucial
55 component of the healthcare ecosystem. While extensive prior work in HCI have investigated the potential of technology
56 in low-cost diagnostics [20, 59], managing and digitizing health records [39], training of healthcare workers [61], and
57 teleconsultation services [8], none of them have examined the role of home phlebotomists. In this paper, we focus on
58 understanding the technology-mediated labor practices of home phlebotomists, amidst the rise in demand of digital
59 telehealth platforms.
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61 The role of home phlebotomists is analogous to platform workers employed in services like food delivery and cab
62 drivers, due to the travel-intensive, customer-facing nature of their work, and increasing adoption of digital technology.
63 Researchers from the HCI and CSCW community have been actively investigating the on-demand labor practices
64 and relations of workers employed on these digital platforms [3, 50, 51]. However, most of these studies investigate
65 platforms employing low-skilled workers (especially drivers for delivery and cab services) [48, 52], with the exception
66 of a few which have studied mid-skilled workers (e.g., beauty workers) [25, 49]. Our paper focuses on mid-skilled
67 healthcare workers possessing professional medical skills on top of routine platform-work skills (like driving).
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69 In this work, we present findings from a qualitative investigation of the digital ecosystem of home phlebotomy. We
70 conducted semi-structured interviews of 16 phlebotomists with experience in home sample collection, and essential
71 stakeholders of their ecosystem including 2 riders and 8 patients. We also observed the entire workday of three home
72 phlebotomists by accompanying them to eight patient houses, to understand their situated practices and interactions.
73 Our study was conducted in two urban cities of India, Bengaluru and Delhi. We found that the digitization of home
74 phlebotomists' workflows resulted in continued location-based surveillance, and enforced them to submit digital
75 evidence of their work. While burdensome, such digital work evidence empowered phlebotomists to justify and
76 safeguard themselves in case of any discrepancies. Furthermore, we found that the patient-facing, high-precision nature
77 of their medical profession placed them in unfavorable situations due to delay and/or error in their service delivery. To
78 navigate such situations, we found that our phlebotomists relied on their strong human support networks, which are
79 built over time through formal and informal communications. Such networks also help them feel socially connected
80 and enable them to negotiate daily workflows, progress in their career, and optimize their earnings. Drawing on these
81 findings, we synthesize key takeaways for HCI researchers, including directions for more equitable futures of platform
82 gig-work, role of home phlebotomists in augmenting teleconsultation services in future, and design considerations for
83 platforms offering home diagnostic services addressing issues around constant surveillance and redundant phlebotomy
84 tech-workflows.
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91 2 RELATED WORK

92 Our work is mainly informed by two areas of relevant research: technology use within healthcare settings and digital
93 on-demand labor practices. Below we discuss prior works in these areas, with a note that none of them aims to
94 investigate home phlebotomy in the context of digital healthcare in India, which is our key contribution.
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97 2.1 Technology Use by Healthcare Workers

98 An important thread of research in HCI has designed, developed, and evaluated technologies for healthcare workers,
99 mainly to support their communication needs [8, 58], and to digitize and manage their workflows [17, 26, 39].
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101 Researchers have investigated the role of communication technologies to enable interaction among healthcare
102 workers, and between healthcare workers and their patients to provide support and teleconsultation [32, 58]. Early
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105 studies in this space focused on delivering teleconsultation services via e-mail [37, 45] and web portals [38]. With the
106 emergence of communication apps (e.g., WhatsApp, WeChat, etc.), recent work explored their usage for facilitating
107 informal patient-healthcare worker communication [18, 30]. For instance, Wang et al. studied the use of nurse-facilitated
108 patient groups on WeChat to compensate for the infrequent in-person consultation with the doctors [58]. Researchers
109 have also examined the use of video-based tools to enable synchronous communication among healthcare workers
110 for skill transfer and training purposes [30, 34]. Larsen et al. discussed how video-based remote teleconsultation
111 allows doctors to transfer their expertise to nurses who are in close physical proximity to the patients [34]. With
112 COVID-19 resulting in burgeoning digital platformization of the healthcare industry globally, recent work have studied
113 the experiences of doctors and patients using teleconsultation during the pandemic [8].
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116 Another body of medical work in HCI has focused on understanding the impact of digital tools, such as Electronic
117 Health Record (EHR) [23, 31], mScan [17], CommCare [39], Open Data Kit (ODK) [26], on managing health data
118 and on the workflows of healthcare workers. Berg discussed the challenges encountered by clinicians while using
119 EHR, given the strict input conditions [7]. Due to the complexities involved, clinicians often resorted to paper-based
120 workarounds [7]. The preference of paper-based records over electronic records was evident even among nurses,
121 particularly in high-risk and time-sensitive medical settings [31]. Likewise, in low-resourced settings, several initiatives
122 have been taken to digitize the workflows of community health workers (CHWs) [17, 39]. For example, researchers have
123 examined the use of mScan to digitize paper-based vaccine forms, and consequently reported decrease in workload of
124 CHWs [17]. However, similar to nurses, CHWs preferred paper-based data collection over digital tools [30, 43], and less
125 tech-savvy workers relied on intermediaries to complete their digital data entry tasks [57]. While digitizing data was
126 intended to ease healthcare workers workflows, it has been found to result in redundancies when introduced not in
127 alignment with their routine workflows [30].
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131 These studies focused on investigating technology use by healthcare workers at the extreme ends of the skill pyramid,
132 mainly high-skilled doctors [8, 15] and low-skilled CHWs [30, 39, 43]. There is a limited understanding of mid-level
133 health workers¹ such as phlebotomists, who forms a core part of the healthcare infrastructure. Hence, it might be
134 of value to understand the workflows and experiences of (home) phlebotomists amidst the rapid digitization in the
135 healthcare sector. Prior work closely related to phlebotomy has focused on devising solutions for distracting patients
136 while drawing blood [53], locating cannulation sites in case of obese and elderly patients [9, 44], and their experiences
137 of taking blood after completing an educational intervention program [10]. Our research specifically aims to contribute
138 a nuanced understanding of technology-mediated interactions and labor workflows of home phlebotomists amidst the
139 emergence of on-demand healthcare platforms in India.
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143 2.2 Platformized Labor and Governance

144 HCI studies have examined the digitally-mediated work practices in app-based gig professions such as cab drivers [48, 52],
145 beauty workers [3, 49], web developers and graphic designers [2, 12], and crowd workers [14, 56]. These studies have
146 highlighted that the introduction of on-demand platforms have given the workers agency to work as and when they
147 want [22, 25, 35]. Specifically, such flexibility results in female workers preferring gig-based platform jobs as it enables
148 them to better manage their household chores along with work [25]. Moreover, platformized work has resulted in
149 increased income due to longer working hours [19]. However, their emergence has also led to work intensification
150 through introduction of additional digital workflows [22], requires them to learn new (digital) skills [3, 40], and engage
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154 ¹WHO defines mid-level health workers as someone who has received a shorter training than a doctor (~2-4 years) and offers clinical care; or, alternatively,
155 engages in preventive care or health promotion [42].
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157 in emotional labor [48]. Additionally, the precarious nature of work and payment uncertainties often force workers to
158 work overtime [36]. Commenting on the workplace relationships and social connections, recent studies have highlighted
159 the prevalence of social isolation in on-demand platform work [21, 51, 62]. Factors leading to isolation include the
160 stigmatized, individualistic, and atomized nature of work [51, 62], absence of worker networks [51], and limited
161 communication with employer [21]. To overcome this, platform workers often resort to online social media to access
162 peer networks [47, 51, 62]. These digital networks are not only used for informal and formal communications [51, 62],
163 but also for organizing collective action and unionizing against organizational policies when needed [40, 62].
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166 Apart from the opportunities and challenges offered by platformization, recent literature investigated the role
167 of algorithmic-mediation in platform work, and found that it has given rise to digital mechanisms for control and
168 surveillance. Studies have discussed algorithms managing, rewarding, and penalizing workers based on a variety
169 of inputs including rating, reporting and surveillance [3, 48, 50]. Anwar et al. found that customer ratings on an
170 on-demand beauty platform were being used to reward or penalize (even terminate) workers [3]. Such performance-
171 based compensation often forced workers to adopt strategies to negotiate and obtain high ratings [3, 25, 40, 48], for
172 instance, engage in ‘emotional labor’ in exchange for good ratings [48]. *Emotional labor* in this context refers to the
173 management of emotions by workers to create a publicly observable facial and bodily display while interacting with
174 customers [27]. Moreover, these rating systems are mostly opaque to the workers [3]. In addition, workers often distrust
175 the algorithms and resort to manual strategies for self-protection. For example, Shannon et al. found that workers
176 employed self-surveillance measures to track their work to combat payment-related discrepancies [50].
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179 More recently, a few studies have investigated the gendered labor practices on platforms offering on-demand beauty
180 services [3, 25, 49]. Raval and Pal [49] highlighted how flexible work hours acted as an incentive for women beauty
181 workers in India to switch from salon-based work to platform work, in spite of safety concerns around traveling and
182 working in unfamiliar environments [3, 25]. In addition, Gupta [25] discussed the often neglected threat and tolerance
183 of verbal and sexual harassment faced by women platform workers.
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186 Most of the existing studies, however, investigate on-demand platforms employing low-skilled workers requiring
187 driving skills, apart from a few which have focused on mid-skilled workers such as beauty professionals [3, 49]. In the
188 context of healthcare, prior work has mainly focused on high-skilled healthcare workers such as doctors and low-skilled
189 healthcare workers such as community health workers. Our research examines an emerging case of platformized labor in
190 healthcare in India, by studying the roles, responsibilities, and technology-mediated workflows of home phlebotomists,
191 who are mid-skilled healthcare workers possessing medical expertise along with routine platform-work skills such as
192 driving.
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195 3 METHODOLOGY

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197 The goal of this research was to understand the home phlebotomy ecosystem in India, including the end-to-end workflow
198 of home phlebotomists, their roles and responsibilities, their interactions with other stakeholders in the ecosystem, and
199 the technology-mediated interactions enabled by the digital healthcare platforms employing these phlebotomists. Upon
200 receiving approval from the Institutional Review Board, the study took place over three months between June–Aug
201 2022, in two cities of India, Bengaluru and Delhi. We conducted a qualitative study, comprising of semi-structured
202 interviews with 16 phlebotomists having experience in home sample collection. The interviews were supplemented by
203 observations of entire workday of 3 phlebotomists. Essential stakeholders of the home phlebotomy ecosystem including
204 8 patients and 2 riders were also interviewed. Riders, also referred as field executives, runner boys, or delivery boys, are
205 responsible for collecting the samples from the phlebotomists and dropping them to a nearby diagnostic lab for testing.
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3.1 Procedure

To understand the digital ecosystem in home phlebotomy profession in India, phlebotomists with experience in home sample collection were recruited from diagnostic labs (like Dr Lal PathLabs, SRL Diagnostics) and diagnostic aggregator platforms (like Tata 1mg, PharmEasy) satisfying the following inclusion criteria: (1) must have served at least 1 million customers and (2) must have a corresponding digital platform. Phlebotomists were recruited through direct outreach and physical visits to such diagnostic lab centers in Bengaluru and Delhi, followed by snowball and purposive sampling until the data reached saturation. A total of 16 phlebotomists involved in home sample collection were recruited for interviews, out of which 10 were interviewed in-person and 6 were interviewed over-telephone depending on their availability and comfort. The phlebotomist interviews consisted of questions around their phlebotomy career (e.g., "describe your journey of becoming a phlebotomist", "what motivated you to choose this profession?"), routine workflow and use of digital platforms (e.g., "describe your typical workday", "how do you receive patient bookings?"), and challenges faced while working as a phlebotomist (e.g., "what are the major challenges of being a phlebotomist?", "what are the workarounds to tackle them?").

| ID | Primary Role/Job | Age | Gender | City | Education | Experience |
|-----|----------------------|-----|--------|-----------|----------------------|------------|
| P1 | Home Phlebotomist | 29 | Male | Bengaluru | DMLT | 2 years |
| P2 | Home Phlebotomist | 25 | Male | Bengaluru | DMLT | 7 years |
| P3 | Home Phlebotomist | 29 | Male | Bengaluru | DMLT | 8 years |
| P4 | Home Phlebotomist | 26 | Male | Bengaluru | DMLT | 9 years |
| P5 | Clinic Phlebotomist* | 23 | Female | Bengaluru | DMLT | 2 years |
| P6 | Home Phlebotomist | 30 | Male | Bengaluru | DMLT | 12 years |
| P7 | Clinic Phlebotomist* | 22 | Female | Delhi | DMLT | 2 years |
| P8 | Home Phlebotomist | 24 | Male | Delhi | DMLT | 2 years |
| P9 | Home Phlebotomist | 24 | Male | Bengaluru | DMLT | 3 years |
| P10 | Home Phlebotomist | 23 | Male | Delhi | B.Sc. in Nursing | 4 months |
| P11 | Home Phlebotomist | 26 | Male | Delhi | B.Sc. and BMLT | 4 years |
| P12 | Home Phlebotomist | 26 | Male | Bengaluru | DMLT | 7 years |
| P13 | Home Phlebotomist | 28 | Male | Bengaluru | DMLT | 9 years |
| P14 | Clinic Phlebotomist* | 27 | Female | Bengaluru | DMLT | 4 years |
| P15 | Clinic Phlebotomist* | 27 | Female | Bengaluru | DMLT | 6 months |
| P16 | Home Phlebotomist | 32 | Male | Bengaluru | DMLT | 5 years |
| R1 | Runner Boy | 36 | Male | Bengaluru | Middle school | 4 years |
| R2 | Rider | 38 | Male | Delhi | M.Sc. in Agriculture | 2 years |
| S1 | Software Engineer | 23 | Male | Bengaluru | Bachelor's | – |
| S2 | Marketing Director | 45 | Male | Delhi | Master's | – |
| S3 | Accountant | 31 | Female | Bengaluru | Bachelor's | – |
| S4 | Retired | 71 | Male | Delhi | Master's | – |
| S5 | Unemployed | 24 | Female | Delhi | Middle school | – |
| S6 | Cook | 32 | Male | Bengaluru | High School | – |
| S7 | Security Guard | 46 | Male | Bengaluru | High School | – |
| S8 | Laborer | 23 | Male | Delhi | High school | – |

Table 1. Demographic information of our phlebotomist (P*), rider (R*) and patient (S*) participants. Note: DMLT: Diploma in Medical Laboratory Technology, BMLT: Bachelor in Medical Laboratory & Technology, B.Sc.: Bachelor of Science, M.Sc.: Master of Science. *: Although their primary job was of a Clinic Phlebotomist, we found them to frequently visit patients' home for sample collection, hence we included them in our study and also refer to them as Home Phlebotomist in the rest of the paper.

261 Apart from phlebotomists, other stakeholders in the home phlebotomy ecosystem, including patients and riders
262 were also interviewed to better understand phlebotomists' interactions with them. Eight patients who had availed
263 diagnostic services in the past 6 months, either home-based or clinic-based were interviewed over-telephone. The
264 patients were recruited from author's personal contacts, followed by snowball sampling. The interviews consisted of
265 questions around their most recent diagnostic test (e.g., "why did you book that test?"), challenges faced (e.g., "what kind
266 of challenges did you encounter while booking the service?"), and their preferred mode between clinic- and home-based
267 phlebotomy (e.g., "describe your experience in phlebotomy services in clinic-based versus home-based settings"). In addition,
268 two riders from diagnostic labs were also interviewed in-person. Riders often had to communicate with phlebotomists,
269 and were responsible for transferring the phlebotomist collected fluid samples from patient's home to the diagnostic
270 lab. The riders were asked questions around their job roles and responsibilities, workflows, and technology usage.
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272 All the interviews with the participants began with a brief explanation of the research and obtaining signature on
273 the consent form. The participants were free to skip answering any question during the interview. The interviews
274 were conducted in Hindi and/or English depending on the participant's comfort, and were audio-recorded with verbal
275 consent of the participants. The interviews lasted 30–90 minutes. All our interview participants were compensated
276 with a mobile recharge or an Amazon gift voucher worth INR 500 for their participation after the interview.
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278 To supplement the interview data, recruited phlebotomists were requested if the first two authors could accompany
279 them on a regular work day in order to observe their situated interactions and practices. The goal was to understand
280 their routine, digital workflows, and their interactions with patients, riders, and other stakeholders of their ecosystem.
281 Three of our interviewed phlebotomists (P6, P13, P16) agreed for the observation study. The phlebotomists informed the
282 patients over-telephone about the researcher's presence prior to their home visit, and obtained consent from them. The
283 researchers entered the patient's house only if the patient agreed. During the observation study, extensive field notes
284 were taken, which were further supplemented by clarification questions to the phlebotomist asked outside the patient's
285 house. The observation study lasted for 16 hours in total with 8 home visits. Phlebotomists were compensated with an
286 additional mobile recharge or an Amazon gift voucher worth INR 500 for their participation in the observation study.
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288 3.2 Participant Demographics

289 The participant demographics are available in Table 1. The average age of our phlebotomists was 26.3 ± 2.7 years,
290 riders was 37.0 ± 1.0 years, and patients was 36.9 ± 15.5 years. While the majority of our phlebotomist participants were
291 primarily employed as home phlebotomists, 4 participants were clinic phlebotomists, who visited patients' houses for
292 home sample collection only in critical cases. Interestingly, all 4 of them were female (while the rest were male). One of
293 our phlebotomists (P12), along with working as a home phlebotomist, was also running his own diagnostic lab under
294 the label of a popular diagnostic aggregator's franchise. The average experience of the phlebotomists was 4.8 ± 3.4 years,
295 ranging from 4 months to 12 years. Twelve of our participants were based in Bengaluru, while 4 were based in Delhi. A
296 majority of our phlebotomists (14) had completed a Diploma in Medical Laboratory Technician (DMLT) which is a
297 requirement to become a phlebotomist in India, the other two participants had more advanced degrees (1 had Bachelor
298 in Medical Laboratory Technician (BMLT) and 1 had B.Sc. in Nursing).
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300 Among the patient participants (2 female, 6 male), 3 were employed in white collar jobs (e.g., accountant, software
301 engineer), 3 were employed in blue collar jobs (e.g., cook, security guard), 1 was retired, and 1 was unemployed. While
302 all the patients had availed diagnostic test services in the past 6 months, only 4 of them had availed a home phlebotomy
303 service. The remaining patient participants either did not feel the need for home phlebotomy, or lacked awareness
304 about the existence of such services. We also interviewed two riders, both male, and with 2-4 years of experience.
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3.3 Data Analysis

The collected data consisted of audio recordings (~23.5 hours) from 26 semi-structured interviews, notes from the interviews and observation study, and photos of relevant artifacts (such as phlebotomy application screenshots, images of medical equipment). The audio recordings were anonymized, transcribed and translated to English before conducting inductive thematic analysis [11]. The field data was read several times by the first two authors, who also conducted the interviews, to identify the initial set of codes. The interviews were separately coded by them. Regular meetings between the authors were held to discuss the emerging codes and discrepancies if any. Multiple-rounds of open coding were conducted and codes were rigorously discussed and refined. The refined codes (e.g., "peer-referring", "redundant tech workflows", "travel-intensive", "varying digital adoption") were finally clustered into high-level themes. Examples of high-level themes included additional support for female phlebotomists, digital surveillance, and uncertainty in compensation.

Although rich data was obtained from the patients' interviews, most of those findings were centered around their reasons and experiences opting for a diagnostic service, rather than their experiences with the (home) phlebotomist. With respect to the rider's interviews, a majority of the findings strongly overlapped with our phlebotomist themes. As a result, the Findings section predominantly draws on the phlebotomist interviews. Patient and rider findings were only used to support emerging themes from the phlebotomist interviews.

4 FINDINGS

Our findings detail the workflow, roles and responsibilities of home phlebotomists, the role of technology acting as enabler and inhibitor in their workflows, the human infrastructures, and their relationship with the different stakeholders in the phlebotomy ecosystem.

4.1 Phlebotomy Workflow and Characteristics

Based on our interview and observation study, here we describe a typical workflow of a home phlebotomist sample collection process (Fig 1).

Diagnostic labs and diagnostic aggregator platforms provide multiple ways to the patient to book appointment for home sample collection, such as using their smartphone/web application, or by calling/messaging their phlebotomist or patient care representative. Depending upon the mode of booking, the patient is either auto-assigned a phlebotomist by the digital platform, or manually by a team of route managers and customer care representatives. The route manager is mainly responsible for assigning neighborhoods (on the basis of zip code) where the phlebotomists (and riders) will operate. Once a phlebotomist is assigned, the patient's details such as address, date and time of sample collection, phone number (by some organizations), and tests to be performed, are shared with them over the phlebotomist's application (Fig 2c) or WhatsApp. The phlebotomist usually calls the patient to confirm the appointment time, and requests the patient to share their 'exact' location over WhatsApp. In case the patient cancels the appointment, the phlebotomist needs to inform their reporting manager about the cancellation.

As per the requirement of sample collection, the phlebotomist visits the Patient Collection Center or the diagnostic lab to collect the required medical equipment (like syringes and containers). With the equipment, the phlebotomist reaches the patient's house at the scheduled time. Inside the patients' house, the phlebotomist introduces themselves, puts on their gloves, sanitizes their hands, and takes out the required equipment (such as syringe, tourniquet, container and bandage) from their sample collection bag (Fig 2a,b) to collect the sample (mainly blood, saliva, or urine). After

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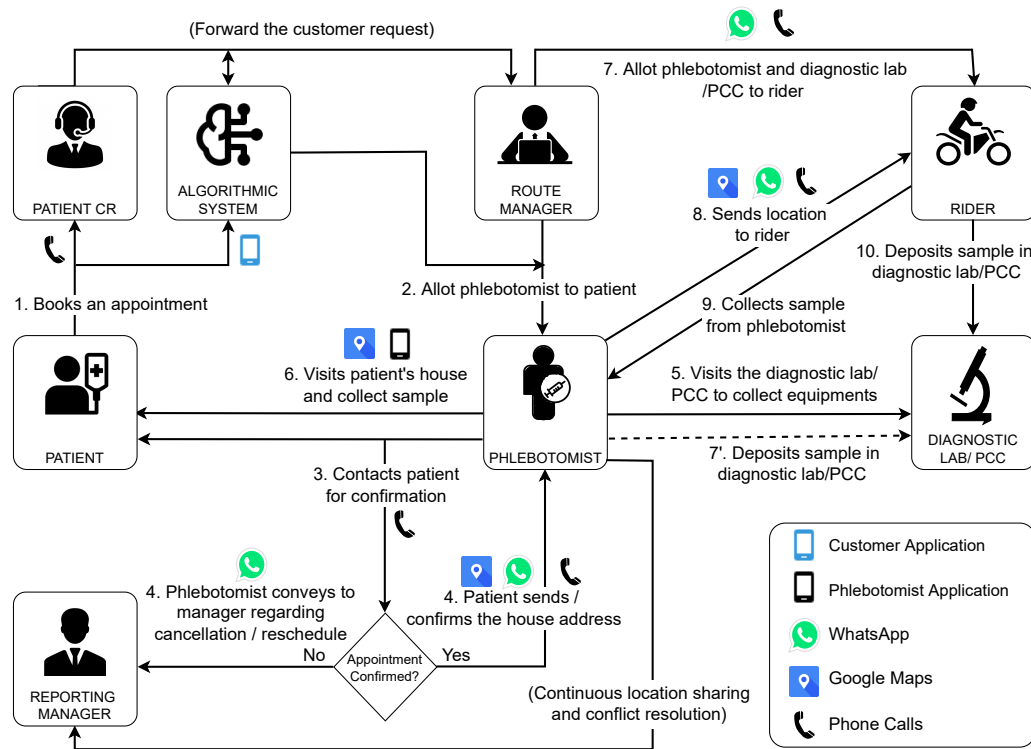


Fig. 1. Ecosystem of the home phlebotomist showcasing the key stakeholders, workflows and interactions. (CR: Care Representative)

that, the phlebotomist sticks a barcode on the collected sample container(s), scans the barcode using their diagnostic lab smartphone application, and clicks and uploads a photo of the collected sample (Fig 2d). Depending upon the organization’s policy, the phlebotomist either deposits the sample at the diagnostic lab themselves, or communicates with a rider to pick the sample from them and deposit it at the diagnostic lab.

4.1.1 Travel-Intensive and Packed Work Schedule. All of our phlebotomist participants reported that their work starts early in the morning (~5 am) and they work till 2 pm. In this 9-hour work shift, the phlebotomists spend most of their time (~6-7 hours) traveling on their motor scooter/bike (Fig 2a), while the actual process of sample collection takes 2-10 minutes per house. This unique work timing (5am to 2pm) allowed home phlebotomists to work another job part-time in the evenings. For example, P13 worked as a food delivery worker for Rapido²:

“Whenever I get time, I check for orders on Rapido. I turn on my availability, and I start to receive orders... I usually work as a delivery person from 5-8 pm, earning 40 rupees (INR) for each order.” (P13)

Another participant, P17, reported working in the marketing department of a diagnostic lab after his home phlebotomy shift. The underlying motivation behind uptake of additional work among our participants was to generate extra streams of income. However, a few organizations (like Dr Lal PathLabs and Apollo Diagnostics) expected their home phlebotomists to be available till 5 pm. During that lean period of 2pm-5pm, the phlebotomists usually reported waiting

²Rapido is an Indian bike taxi aggregator and logistics service provider based out of Bengaluru.

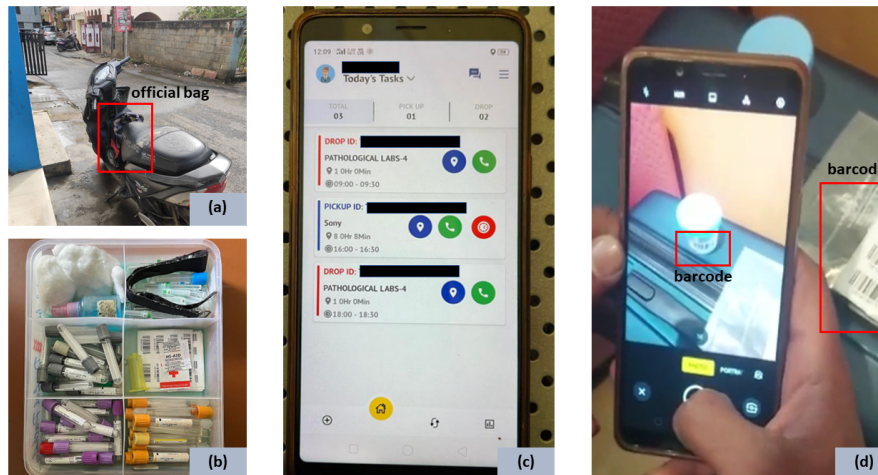


Fig. 2. Images captured during the observation study: (a) Motor scooter of the phlebotomist with the official bag, (b) medical equipment inside the bag, (c) interface of the phlebotomist application listing the pickup and drop details of three samples, and (d) phlebotomist clicking an image of a sample container with barcode pasted on it using the phlebotomist application.

at their respective diagnostic labs (or Patient Collection Centers) to fulfill ad hoc orders. While waiting in the diagnostic lab, the home phlebotomists were expected to act as clinic phlebotomists, and collect samples of walk-in patients. However, they received no additional compensation for these services. On the flip side, the clinic phlebotomists often went beyond their assigned responsibilities to accommodate critical patients (e.g., senior citizens, bed-ridden patients) and reported visiting such patient's house for sample collection [6]. The clinic phlebotomists did not receive any extra compensation for those visits, only the transportation cost was reimbursed. Thus, the unpredictable schedule of sample collection often resulted in blurred boundaries of work between the clinic and home phlebotomists.

Amidst their packed schedule of sample collection, our phlebotomists reported juggling between travel, sample collection, and essential activities like eating and using the washroom. The travel intensive nature of the job, coupled with technology usage, often led them to compromise on their road safety, as P3 said, "*we have to talk continuously while driving... we keep getting calls from customers.*" Our home phlebotomists did not have dedicated time slots to communicate with the patient, hence they have to manage such communications on the go. They further complained that no extension in the scheduled time slot is provided to account for traffic and weather-related delays. Specifically, the rainy season not only results in increased travel time (due to heavy traffic caused by waterlogging on the Indian roads [55]), but also increased number of bookings.

"In the (rainy) season, we get around 10-15 orders a day, whereas in the non-season, only 5-6 orders... Summer is over, so the weather will be very cloudy and rainy. During this time, many people will experience fever and other symptoms... and doctors will ask for more tests." (P3)

Finally, we found the home phlebotomist work to be repetitive in nature, requiring minimal learning of new skills. The monotonicity of the work might lead them to skip key steps in their workflow. For instance, during the observation study, we noticed that P16 in one of the sample collections neither wore mask nor gloves, risking both their own and the patients' safety.

469 4.1.2 *Uncertainty and Unpredictability in Compensation and Career Growth.* We observed that the payment structure
470 for clinic and home phlebotomists was similar across the organizations: clinic phlebotomists received a fixed monthly
471 salary, while home phlebotomists received an incentive of 50-200 INR per house of sample collection along with the
472 fixed monthly salary of 20,000-30,000 INR. This is, however, different from other platform workers (like cab drivers or
473 food delivery workers), whose compensation structure lacks a fixed component [25]. We found the incentive component
474 of home phlebotomists to depend on factors such as type of the test and distance traveled by the phlebotomist for
475 sample collection. Our home phlebotomists reported that a significant portion of their incentive component was used
476 for their vehicle's maintenance and fuel cost.
477

478
479 Before COVID-19, a majority of our home phlebotomists were clinic phlebotomists. The pandemic accelerated the
480 uptake of the home phlebotomy phenomenon in India, and organizations started offering clinic phlebotomist incentives
481 for home visits. Interestingly, over the past two years, the incentives for home visits have reduced and even the incentive
482 structure has evolved. Earlier, organizations paid incentives based on per patient sample collection, which has now
483 been updated to incentive paid at a house level:
484

485 “The sample collection charge now is based on a house level. If there are four customers in the same
486 house, we will get only 100 (INR). During the second wave and third wave (of COVID-19), it was
487 patient-based... we would get 400 (INR), if there are four customers, even in the same house.” (P9)
488
489

490 P9 further explained the rationale behind the high incentive during COVID-19: “*there were very few home collection*
491 *staff (phlebotomists) at that time, because all phlebotomists were getting tested (COVID-19) positive.*” Thus, to address
492 the high demand of COVID-19 testing and lack of COVID-19 negative phlebotomists, organizations incentivized the
493 phlebotomists with higher pay.
494

495 In addition, our participants disclosed that their salary and yearly increment were mainly dependent on the organi-
496 zation's policies rather than on their years of experience as a phlebotomist. Discussing their career trajectory, we found
497 our participants lacking a defined vision of their career growth. They were unaware of the designation after their next
498 promotion. Despite that, a few phlebotomy participants aspired to become a lab technician as it is a “*less travel-intensive*
499 *job*” and utilizes their sample testing skills which they learned during their phlebotomy education. Others expressed
500 the desire to be promoted to the role of a reporting manager or route manager. With high hopes, P11 said,
501

502
503 “Who knows? Maybe the company (organization) would promote me to route manager. I know all the
504 routes, so I am eligible to become a route manager. The current route manager used to be a phlebotomist
505 with us earlier.” (P11)
506

507 Despite the unclear career progression, our participants aspired for “senior” roles, enabling them to earn more money
508 and/or ease the travel-intensive nature of their work.
509
510

511 4.2 Role of Technology in the Phlebotomy Ecosystem

512 We observed a varying level of digital adoption among organizations offering home phlebotomy services. Most organi-
513 zations (like Dr Lal Pathlabs and Apollo Diagnostics) had their own digital platform for both the phlebotomists and the
514 customers, while those without a digital phlebotomist platform (like Aarthi Scans & Labs) relied on WhatsApp/Telegram
515 for communication. Despite having an official platform, we found our phlebotomists relying on additional applications,
516 like navigation apps (mainly Google Maps) and communication apps (mainly WhatsApp) to enhance their workflows.
517 In addition, none of the organizations, except Healthians, had a digital platform for riders. Below we discuss the role
518
519
520

521 of technology in surveilling the phlebotomists, opaqueness of the reward structure with respect to rating, and our
522 participants' coping strategies when technology breaks down.
523

524 *4.2.1 Digital Surveillance as Inhibitor and Facilitator.* All our phlebotomists reported that they were constantly tracked,
525 either by the phlebotomist work application which required them to keep the GPS turned on, as phlebotomist P6 said
526 “*the app does not function without GPS*”, or by the organizations' requirement that the phlebotomist need to regularly
527 share their location to their reporting manager on WhatsApp. We sensed an overall acceptance of such location-based
528 tracking among our phlebotomists. A few phlebotomists even believed that by tracking their location during work hours,
529 the organization will safeguard them against any unwanted situation. This demonstrates that phlebotomists trust their
530 organization to use surveillance data for their benefit rather than using it to 'surveil' them. Apart from location, a few
531 participants were required to share their selfie every morning to mark their attendance. Such photo-based surveillance
532 measures were not limited to selfies:
533
534
535

536 “In the (phlebotomist work) app, when we login (in the morning), the app asks us for a selfie, photo of
537 our bag, temperature gun, and bike's photo.” (P8)
538

539 In addition, our phlebotomists were instructed to use the in-app calling feature instead of using their personal phone
540 numbers to contact the patients, to preserve privacy of both the parties. However, two participants expressed their
541 apprehensions, stating that “*the company (organization) people record these calls*” (P8). It is interesting that although
542 phlebotomists were fine with the constant location tracking and image-based surveillance of their work life, there was
543 still hesitancy with respect to the organization's listening to the patient-phlebotomist conversations.
544
545

546 Furthermore, our phlebotomists were required to submit digital evidence for every part of their workflow. For
547 example, upon leaving for a sample collection order, our phlebotomists needed to click the "Start" (button) in their
548 application, and upon reaching, they had to click the "Reach" button. They also had to capture and upload a photo of
549 the collected sample (Figure 2d). It was a required step in their application workflow. These photos acted as a proof
550 that they collected the correct number of vials (tubes), and that each vial is correctly labeled. While our phlebotomists
551 used digital platforms for each work action, from receiving bookings to collecting samples, we observed that they had
552 limited controls over certain functionalities. For instance, phlebotomists could not reschedule/cancel a booking, and
553 thus had to contact the phlebotomist care representative or their reporting manager for that. P8 described,
554
555

556 “To reschedule an appointment, we message in the WhatsApp group, ‘*please reschedule, patient doesn't*
557 *want to get tested now*’... We do not have the rights to reschedule. It can be done by either the backend
558 team or our manager or the patient. We cannot do it. Similarly we cannot modify patient details.” (P8)
559

560 Such limited controls often resulted in redundant workflows involving other team members. Moreover, it required the
561 phlebotomist to provide justification for their actions. If the phlebotomist raised the request for rescheduling due to
562 personal reasons (like emergency at home, bike accident), they were asked a multitude of questions by the phlebotomist
563 care representative, e.g., “*It wasn't easy to get it rescheduled, we had to provide a lot of justification... like why are you*
564 *getting it rescheduled? what work do you have? etc etc... they would ask us to complete our bookings and then do our personal*
565 *work*.” Even if the patient asked the phlebotomist to reschedule or if the patient is unreachable, the phlebotomists were
566 required to submit proofs such as call recordings of the patient requesting reschedule/cancellation or screenshot of call
567 logs showing unresponsive patient. This hints that the organizations placed minimal trust on their phlebotomists for
568 crucial decision-making, which is in contrast with the immense trust placed by the phlebotomists on their organizations.
569
570
571
572

573 Although the process of submitting digital evidence (in the form of photos, call logs, and audio recordings) is
574 burdensome, we found that these evidences can help to defend themselves and justify their actions. For example, P8
575 described an incident,
576

577 “Clients can lie sometimes (to the customer care representative)... for example, one of my clients said: ‘I
578 was waiting for the phlebotomist. I did not receive any calls... I am in a network reachable area only’. My
579 call history saved me at that time.” (P8)
580

581 Overall, we found these digital platforms being used by the organizations to exercise and govern control over the
582 workflows of phlebotomists, also reflective of their authority, however on the flip side, it can help in safeguarding
583 phlebotomists’ interests in unprecedented situations.
584

585 **4.2.2 Digital Ratings induce Penalties and Rewards.** We found all the organizations (where our phlebotomists were
586 employed) allowed the customer to rate the phlebotomist and provide feedback, however the phlebotomist could not
587 rate their patients. A few phlebotomists reported having no monetary impact of customer ratings, while others reported
588 getting penalized and rewarded based on ratings. Our phlebotomists lacked a definitive understanding of the rating’s
589 impact on their compensation. Interestingly, one of our phlebotomists hoped to get a monetary incentive for his high
590 rating: “Patients have to rate us... My rating is 4.9 (out of 5). See it’s shown here in the application along with my name and
591 photo. This rating has no impact on my salary... I wish it had an impact.” On the other hand, phlebotomist P3’s incentive
592 was dependent on the customer’s feedback. He reported, “For every sample collection, we get paid between rupees 160
593 to 190, based on the customer’s rating in the app.” However, P3 was unclear on how the exact amount is calculated on
594 the basis of patient’s rating. Similar to our findings, prior literature in gig economy and on-demand platforms has
595 extensively discussed the impact of ratings on worker’s incentive [3, 48]. Our patient interviews revealed that they
596 assumed that there was no direct impact of rating on the phlebotomist’s compensation. If they would have been made
597 aware of the impact, the customers would have rated the phlebotomists more generously.
598

599 In addition to customer rating, all our phlebotomists were tracked for delays in home sample collection, usually
600 with a buffer period of 10-30 minutes from their scheduled time. Depending on the organization, a few phlebotomists
601 mentioned weekly/monthly delay reports being shared in their WhatsApp group to receive appreciation or humiliation
602 from other phlebotomists group members, without any monetary deduction.
603

604 “We receive a message on WhatsApp group every week showing who completed their collections
605 on-time, who all delayed how many orders... Others comment on it... They say that this much salary
606 will be deducted, but they haven’t deducted anything till now... They do these things to scare us.” (P11)
607

608 However, few organizations did penalize the phlebotomists for such delays. P3 described a tech-facilitated penalization:
609

610 “If the first customer’s appointment is early morning like 5 am, then we cannot delay that appointment...
611 It’s the company’s rule and we have to pay a penalty. If I am late by more than 10 minutes on my first
612 visit, then 200 rupees (INR) get deducted... If we do not get any penalties in a month, then the company
613 pays us 2000 rupees (INR) extra.” (P3)
614

615 Overall, we observed a mixed impact of rating and delay in sample collection on the phlebotomist’s compensation.
616 Moreover, we found the impact to be opaque for both the patient and the phlebotomist.
617

618 **4.2.3 Technology Breakdown, Limitations, and Workarounds.** Although the adoption of digital platforms within home
619 phlebotomy is accelerating, the technology is still in its nascent stage and we found it to fail often, with the phlebotomists
620

625 resorting to innovative workarounds. To begin with, the patient location displayed in the phlebotomist's application
626 was often inaccurate. As a result, our phlebotomists relied on alternative workflows, using a combination of phone calls,
627 location sharing over WhatsApp, and Google Maps to navigate to the patient's house, resulting in redundancy. P1 said,
628 *"The application has the patient's location, but it's incorrect mostly. We call the patient and request them to WhatsApp their*
629 *location."* However, such workarounds unknowingly compromised privacy of both the patient and the phlebotomist.
630 Organizations usually mask the patient's contact number on the phlebotomist application, and when the phlebotomist
631 calls the patient using their work application, the phlebotomist's phone number is hidden from the patient. However,
632 due to inaccurate location, we found the phlebotomist requesting the patient to share their location over WhatsApp,
633 resulting in both the parties sharing their phone number with each other, thus unintentionally breaching the privacy.
634

635
636 Home phlebotomists require a working smartphone with good internet connection for communication, navigation
637 and to complete their workflow. In our observation study, one of the phlebotomist realized his smartphone's battery to
638 be low during his first sample collection of the day. He quickly contacted a few of his friends and borrowed a power
639 bank from one of them. Our phlebotomists thus remained resilient and sought help from their personal networks and/or
640 developed other workarounds to cope with technology breakdown during work hours. To exemplify, a phlebotomy
641 participant described borrowing patient's WiFi due to low network connectivity in that region:
642

643
644 *"In some people's home, the connectivity is not that good. If the customer has WiFi, we borrow it from*
645 *them. If they do not have WiFi, then we go outside their home to check the details on the app, come*
646 *inside and collect the samples, and again go outside to complete the work order entry (in the app)."* (P3)
647

648
649 In addition, algorithmic assignment of phlebotomist to patients had issues. In most cases, phlebotomists were assigned
650 bookings based on zip codes. However, the technology is not robust enough to account for unforeseen circumstances,
651 such as if a phlebotomist takes a leave, or a last minute vehicle breakdown of the phlebotomist. The route manager was
652 responsible to handle such cases.

653 Besides unexpected breakdowns, our participants mentioned several limitations of current technologies. State-of-the-
654 art technology cannot verify the information entered by the patient while booking. For example, most organizations
655 prohibit home sample collection for children below 5 years of age. P3 mentioned,
656

657
658 *"Home sample collection of someone less than 5 years old, that is kids, is a bit difficult. So sometimes*
659 *they (customers) enter an increased age of the kid and book the test. We then face problems once we*
660 *reach their home for sample collection."* (P3)
661

662 In addition, a few digital platforms require their phlebotomists to collect sensitive patient-health data (such as blood
663 group, weight, height). During our observation study with P16, we noticed P16 lacked understanding of the sensitivity
664 and criticality of such patient health information, and how it will be utilized by the organizations. This resulted in the
665 phlebotomist inaccurately filling the health data as per their own judgment, without even asking the patient. On the
666 other side, a patient participant (S1) shared that the customer application of his preferred diagnostic lab recommends
667 him diagnostic tests, most likely based on his age, gender, height and weight. Thus, inaccurate demography data entry
668 by the phlebotomist can have a negative impact on the patient.
669
670

671 4.3 Human Infrastructures in Phlebotomy Work

672
673 Apart from technological infrastructures, our phlebotomist participants leveraged several human infrastructures at
674 various stages of their professional journey. Here, we discuss the labor relations and interactions of phlebotomists with
675

677 other stakeholders in the phlebotomy ecosystem including rider, patient, and organization. We also discuss the role of
678 their personal and professional networks acting as their support system, particularly for female phlebotomists.
679

680 *4.3.1 Interactions within Phlebotomist Ecosystem.* The phlebotomy ecosystem comprise of multiple stakeholders. We
681 focus on the three key stakeholders—rider, patient, and organization—and discuss their interactions with the phlebotomist.

682 **Phlebotomist-Rider Relationship:** Riders are key to the home phlebotomy service, but are completely invisible to
683 the patients. The prerequisite for the rider position is that the individual must have a driving license and access to a
684 motor scooter/bike. One of our riders stated that women are not preferred for the job because of the intensive travel
685 requirement. He shared,
686

687 “It’s a very risky job. Sometimes even at night, we have to ride a bike... Ladies can’t be hired for our job.
688

689 It’s not that they can’t do the work, but it might be hard for the ladies to ride 200 kms everyday. Some
690 (of us) even have to ride 300 kms a day.” (R1)
691

692 Moreover, riders are expected to be smartphone users. The adoption and utilization of technology by riders varied
693 across organizations. For example, organizations required their riders to constantly share their location during work
694 hours through the official rider application (by turning on the phone’s GPS), over WhatsApp messaging, or by carrying
695 a separate GPS device. Riders were also asked to update the sample collection status (“*received*” from the phlebotomist,
696 “*deposited*” at the diagnostic lab) either in the rider application or by sending a message in their WhatsApp group
697 (comprising of the home phlebotomist, rider, route manager, and reporting manager). The rider met the phlebotomist
698 either at the Patient Collection Center (PCC) at fixed schedules throughout the day (e.g., 10 am, 1 pm, etc.), or they met
699 on the roadside at a mutually convenient location. P9 shared,
700

701 “A runner comes here at 1 pm... There are several PCCs... There are several batches—the first batch is at
702 10 am, the second batch is at 1 pm, and then at 3 pm and 5 pm. A runner arrives to collect the sample at
703 each batch time and transports it to the main diagnostic lab.” (P9)
704
705

706 In case of P16 and his rider, their meeting location was fixed, and the timing of the meeting was conveyed to the rider
707 by the phlebotomist based on the sample collection status. We present a vignette from our observation study:
708

709 After collecting samples from the patient’s house, the phlebotomist stops at a small tea shop on the
710 road to have a cup of tea with biscuits and cigarette. He smokes a cigarette as he waits for the runner.
711 The runner arrives, scans the bar code pasted on the sample test tubes using his smartphone app, and
712 marked it as “received”. After completing the task, the phlebotomist shares a cigarette with the runner.
713 Then the runner departs to drop the sample in the diagnostic lab.
714

715 This workflow helped home phlebotomists to socialize and strengthen their relationships with other stakeholders in
716 the ecosystem, particularly riders.
717

718 **Phlebotomist-Patient Relationship:** Home phlebotomists directly interact with patients, acting as the face of the
719 organization. This patient-facing role provides phlebotomists an opportunity to build deep relationships with them.
720 Such relationships helped our home phlebotomists in obtaining more sample collection orders, with the customers
721 directly calling the phlebotomist to book their next diagnostic tests. For instance,
722

723 “I used to take patients’ complete medical history, like which diseases they have? Then I used to send
724 reminder messages for their upcoming tests. For example, if there’s a thyroid patient, then I used to call
725 once every three months and say, ‘*Ma’am, it has been three months, did you get your thyroid tested? If*
726 *you haven’t gotten it done, then should I come tomorrow?*’ They will usually say, ‘*Yeah, just come.*’ (P12)
727
728

P12 displayed care for his patients and developed great relationships with them, which encouraged him to open a diagnostic lab with his trusted base of customers. We found our patient participants reciprocating that relationship by referring their trusted home phlebotomist within their social circle.

While a majority of patient-phlebotomist interactions were positive resulting in building trust, during our interviews a few participants shared negative experiences as well. Among our patient participants, such complaints comprise of error in the sample collection technique of the phlebotomist, or the phlebotomist reaching late for sample collection. For instance, patient S2 shared that she lost her temper and, *“called the patient care (representative) as the person (phlebotomist) who was sent did not have enough experience in taking blood samples... even after pricking twice, he failed to draw blood.”* Similarly, P13 was publicly humiliated by an elderly patient on reaching his location late. He narrated,

“I already informed him an hour back that I will reach by 8 o'clock... Because of the traffic, I was 10 minutes late. When I went (reached) to the customer's location, he started scolding me outside of his house. Everybody was watching that... We are professionals. How can we take all this? I left and informed the team (manager) that the customer did that.” (P13)

Irrespective of the patients' behavior, we found our phlebotomist participants to be empathetic towards their patient. Such incidents highlight patients' high expectation of on-time, error-free service from home phlebotomists, which they might have come to expect because of their past positive experiences with phlebotomy services in India. Defying these expectations, a sentiment that echoed across our phlebotomists was put into words by P6: *“In any work you do, 100 percent accuracy cannot be guaranteed.”* In addition, despite having a professional degree, our phlebotomists reported being treated with minimal respect by a few patients. P8 stated that the phlebotomist's job is a *“very thankless job where every moment we have to justify ourselves and (for the organization) the client is always correct.”*

The absence of a grievance redressal mechanism for the phlebotomists' work-related issues demonstrate the organization's stance of preferring patients over phlebotomists.

Phlebotomist-Manager Relationship We found that home phlebotomists working for diagnostic aggregator platforms (like Tata 1mg, PharmEasy) were hired on a contractual basis, while phlebotomists associated with diagnostic labs (like Dr Lal PathLabs, Apollo Diagnostics) were permanent employees of the organization. The latter is in contrast with a typical platform economy model, wherein workers are employed on a contractual basis. Although none of our phlebotomists received benefits like health insurance, vehicle insurance from their organizations, all of them reported receiving reimbursement of smartphone talk-time and data monthly bills.

Our phlebotomist participants mentioned that they refrain from arguing with the customer, even after receiving disrespectful comments, as it would negatively impact the reputation of their organization. This illustrates the organization-first approach followed by our phlebotomists. P12 adopted the following strategy:

“When the patients begin to yell, I try to calm them. If they are calm and convinced, then that's good. If they are not, I leave and tell my manager the entire event. I tell him: *‘If you receive a call about it, please handle the situation’*... The manager does not support anyone. He will shout at us first, and later he will shout at the patient behind his back.” (P12)

In the absence of a formal grievance redressal mechanism, our phlebotomists trusted their reporting manager and reported unpleasant patient encounters to them immediately. They also reported seeking support and advice from their fellow phlebotomists. Such a support structure is highly valued by them. In addition, phlebotomists mentioned receiving verbal instructions from their reporting manager on behalf of their organization to *“increase business”* by enrolling new patients at the residence of the scheduled patient, recommending new tests to the scheduled patient (if

needed), and informing patients about test packages and ongoing deals. Occasionally, monetary rewards are associated with it to encourage phlebotomists.

“If we feel that we should recommend these tests, then we do recommend them. We are also advised from the company’s end to add extra tests and increase the sales... We get a 20% commission on such test referrals.” (P3)

Such revenue-boosting techniques not only help the organizations to increase their sales but also help the phlebotomist to earn more.

4.3.2 *Personal and Professional Networks of Support.* Most of our phlebotomists’ choice to pursue phlebotomy as a career was highly influenced and conditioned by someone within their closed personal network (e.g., friends, family), who were already working as a lab technician or in a related area like nursing. People in our participants’ personal networks talked affirmatively about the future scope and career opportunities in this profession, as P1 mentioned, “*my friend was also doing it (DMLT)... he told me that there’s ample scope, so I went in and did it.*” Similarly, P6 mentioned how the presence of 8 lab technicians within his family nurtured his interest since early years:

“From 10th standard, I was interested in (the profession of) Lab Technician only. There are 8 lab technicians in my house (family)... all my brothers, sisters and cousins. My brother guided all of them. He works in a hospital himself.” (P6)

Besides playing an influence in career choice, our phlebotomists reported continued utilization of these personal networks as they ventured into the job market. Seven phlebotomists mentioned that they were referred to their first job by a friend or relative already working in that organization, for example, P13 said, “*My friend was working in <name of an organization>... he suggested me to apply and referred me here.*”

While working as a home phlebotomist, our participants established a strong professional network with other home phlebotomists across organizations, and with other stakeholders in the phlebotomy ecosystem (like runners and managers). This resulted in blurring of boundaries between personal and professional networks. Our phlebotomist participants continued to exploit these networks to seek support, negotiate and optimize for their daily workflows in the later stages of their career. Whenever in need, we found our participants to delegate their assigned orders among their closed network of phlebotomists (within organization), as P8 described,

“Suppose if I have collections in my ID, but I can’t go as I am not feeling well. I will just ask some other phlebotomist where you are... if he said *Moti Nagar* (name of a locality in Delhi), then I’ll request him to do my *Moti Nagar* orders. Similarly, one of the phlebotomists today had to get his bike serviced, so he asked me if I can do his orders, and hence I am doing his collections as well.” (P8)

Interestingly, we noticed that our phlebotomists often transferred orders within their closed networks to optimize their earnings. They either borrowed bookings from their friends or transferred their own bookings to a friend phlebotomist when the incentive component was not lucrative enough provided the travel cost and time required for that sample collection, as P8 mentioned, “*... traveling that far for a single collection will be stupid... it will take a lot of time... that’s why we ask someone else to do it.*” Upon mutual agreement, our participants at times got the bookings transferred among themselves through the reporting manager and phlebotomy care representative. Despite the rigorous schedule and variable pay, our phlebotomists used these strategies within their networks to maximize their income. For example, P8, who was assigned mere two bookings for the day, described collecting more than 15 orders by borrowing orders from his friends.

833 Finally, one of our home phlebotomists who is now also an entrepreneur running his own diagnostic lab, discussed
834 the importance of personal and professional network built over the years while operating his own diagnostic lab. He
835 leveraged his network of phlebotomists, friends running other diagnostic labs, and his trusted patients, in the day-to-day
836 operations of his organization.
837

838 Overall, we found that the phlebotomists are a part of a close knit network that is utilized in different stages of their
839 professional career for optimizing workflows and career advancement.
840

841 *4.3.3 Multi-faceted Support for Female Phlebotomists.* Our phlebotomist participants pool comprised of 4 women,
842 who were primarily recruited for clinic-based phlebotomy work, but were also involved in home sample collections.
843 Home phlebotomy service has a male-dominated workforce [46] perhaps due to the travel intensive nature of work and
844 safety concerns associated with home visits, which also resonates with other similar on-demand mobile professions
845 like cab drivers and food delivery workers [3, 25, 49]. Despite that, our 4 female phlebotomists reported having access
846 to multi-faceted support that extends across both professional and personal front.
847

848 Three of our female phlebotomists did not have access to a vehicle for commute, which is often a prerequisite for
849 a home phlebotomist. However, all of them received commute support from their personal or professional network.
850 While one of them was provided a car with driver by her reporting manager, another participant talked about the
851 immense support from her husband, who not only motivated her for the phlebotomy education, but also takes her
852 around for home sample collection. She said,
853

854 “My husband helps me a lot... since I was studying DMLT. If he’s at home, he’ll only take me for sample
855 collections. If I do not know the place where I have to go for collection, or do not get an auto(-rickshaw),
856 or if it is raining, he takes me to that place and waits outside (the house).” (P15)
857
858
859

860 Besides commute, we observed female phlebotomists receiving additional support from their employers to ensure their
861 comfort and safety. For instance, P5 agrees to visit a patient home for sample collection only if at least one female is
862 present in the house: “*If there are only males, then I will not go. If there are female family members, then only I will go.*
863 *Otherwise, my senior will send someone else.*” Access to such support to female phlebotomists would help in bringing
864 more female workers to this otherwise male-dominated workforce.
865

866 To minimize privacy risks, two of our female phlebotomists were advised not to use their personal phones to
867 communicate with patients, and only rely on the official smartphone for such communication. Our female participants
868 mentioned receiving strong peer-support at the workplace which helped them in learning and upskilling, as well as in
869 maintaining a work-life balance. (Note: None of our 12 male phlebotomist participants mentioned peer-training.) For
870 example, P15 described how her senior colleague taught her the procedure to draw multiple blood samples quickly:
871

872 “She is senior to me... she has vast experience. I learnt from her how to work with huge volume of
873 patients... I have now collected even 500 blood samples at one go, in camps.” (P15)
874
875
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877 We found phlebotomists often rely more on peer-based training mechanisms to learn and improvise their daily workflows.
878 The unsaid understanding and support among peers, helped in division of responsibilities in a mutually convenient
879 manner, also helping them take out time for personal chores. For example, P14 said, “*We go home during lunch. If a*
880 *patient calls, then we travel back immediately. In case of busy schedule, we take half an hour break, one person will go and*
881 *come, the other person will go and come—that’s how we manage it.*”
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5 DISCUSSION

Our findings detailed phlebotomists' workflow, the role of human infrastructures throughout their phlebotomy career, their labor relations and interactions with other stakeholders in the ecosystem, and the crucial role of technology. We observed that while the increased digitization and platformization facilitated home phlebotomists in conducting their workflows more efficiently, it also served as a tool for organizations to constantly surveil their work and movements through technology-based evidence. We now reflect on what our findings might suggest for researchers interested in understanding the future of health and healthcare workers. In particular, we first offer insights to design for more equitable futures of platform gig-workers, then outline the future of platformized health, and finally discuss design implications for telehealth platforms offering home diagnostic test services.

5.1 Towards Equitable Futures of Platformized Gig-Workers

Several comparisons and contrasts can be made between the workflows and platformization of home phlebotomists with (traditional) platform workers employed in other professions. We believe that learnings from the home phlebotomy context might extend and help in envisioning more equitable futures of other platformized workers, also called gig-workers. Prior research has highlighted several challenges faced by gig-workers [40, 48]. First, the absence of fixed physical workplaces and limited worker networks lead to atomization and isolation among gig-workers [51, 62]. As a result, they tend to find online worker networks for seeking companionship and instrumental support [51]. While home phlebotomy shared several similarities with typical on-demand platform work, its infection-risky characteristic made it uniquely challenging. Despite that, phlebotomists did not receive the kind of respect and dignity they expected from the patients due to the perceived biases against 'door-to-door' work. In such situations, we found our home phlebotomists to rely on their strong human support system consisting of their professional networks. Moreover, their workflows were organized in a manner that required them to frequently interact with other stakeholders of the healthcare ecosystem—during sample collection and submission, while delegating orders, and even for grievance redressal. This in turn enabled them to socialize and build strong peer networks. We believe that situating such human infrastructures within the platform ecosystem is essential to support workers during their tasks. Furthermore, digital tools can be augmented to provide worker's access and facilitate interactions with these support networks.

Second, traditional on-demand platform workers are generally paid per task [40], leading to precarity in payment conditions [12, 40, 47, 60]. Despite the "gig" nature of our home phlebotomists' work, their salary consisted of a fixed component accompanied by an incentive per sample collection, which helped in ensuring a minimum salary. However, we found our home phlebotomists pursuing additional jobs (similar to prior findings in gig-worker literature [36]), with the key motivation of generating extra income. In contrast, for other platform workers, it was the precarious conditions that motivated them to pursue additional jobs [36]. Very recently, on-demand platforms such as *Zomato* started experimenting with a compensation model that ensures their food delivery workers a minimum fixed income along with an incentive per delivery [28]. Such an incentive model might help in reducing the uncertainty around the compensation structure of platform work.

Third, past studies in ride-hailing literature have reported drivers regularly engaging in 'emotional labor' in exchange for higher ratings [48], as ratings for gig-work has been found to be directly linked with rewards and penalties. Apart from compensation, the customer ratings are sometimes used to classify drivers into categories like gold and platinum [13]. Our findings also described the use of digital ratings provided by the patient to surveil phlebotomist's performance. However, only one organization regulated phlebotomist's monetary compensation based on their digital ratings. Since

937 the digitization in home phlebotomy is still at its nascent stage, rating mechanisms and its impacts were mostly opaque
938 to the phlebotomists. Similar to other gig-work, we found home phlebotomists to engage in emotional labor with
939 their patients as well, but primarily due to their medical responsibility of comforting the patient. While there are
940 immense opportunities for the phlebotomy ecosystem to learn from the merits and failures of the rating system in
941 typical on-demand platforms, it might be of value to understand how algorithmic ratings in telehealth services impact
942 the trust between patients and healthcare providers. More specifically, *what will be the patient's perception towards a*
943 *low-rated phlebotomist or towards a non-“premium” phlebotomist?*
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946 Lastly, prior studies in on-demand platform literature have highlighted the lack of trust among workers with regards
947 to the platform [40, 50]. Specifically, the key reasons behind distrust has been identified as unfair compensation
948 practices [50], and unnecessary and unexpected surveillance [50]. While a similar sentiment echoed among our
949 phlebotomists with regards to submission of digital evidence and need to constantly justify their work, interestingly, we
950 observed that our phlebotomists trusted their organizations. The reason for such trust could be linked to the presence
951 of human infrastructures consisting of reporting manager, route manager, and peers to share, discuss and solve complex
952 problems (related to compensation, surveillance, or customer complaints). In a typical gig-work, due to the absence of a
953 human face, the worker can only rely on their on-call care representative, who lacks agency and training to provide
954 support and address their grievances.
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957 The learnings from our study could help envision a *hybrid model* of platform work, where both human infrastructures
958 and digital platform augments each other and not every workflow needs to be algorithmically-mediated, where the
959 compensation is a combination of fixed payment with per task incentive, where the impact of ratings is transparent
960 to both the parties (workers and customers), and where there are visible human middle management to support the
961 workers.
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964 5.2 Future of Health Platformization

965 Our findings provide a nuanced understanding of home phlebotomists' responsibilities, reliance on human infrastructure,
966 and the role of technology platforms mediating their workflows. Apart from home phlebotomy, such telehealth platforms
967 offer a suite of patient-centric services. We believe that these services, particularly teleconsultation and home phlebotomy,
968 has potential to complement each other to improve the healthcare delivery. Due to the patient-facing nature of home
969 phlebotomist's work, we anticipate that they could act as an intermediary between the doctor and the patient, thus
970 substituting for the doctor's physical presence at the patient's home during teleconsultation. For instance, Bhat et
971 al. [8] highlighted the challenges faced by a patient in maneuvering the phone camera to capture themselves during
972 a dermatology teleconsultation session. Such assistance could be provided by the home phlebotomist in the future.
973 In addition, phlebotomists could assist the patient in better understanding the doctor's instructions with regards to
974 treatment, adding a physical human touch to the otherwise remote teleconsultation service. With adequate training,
975 there is a possibility to expand the role of home phlebotomists. For example, they could also measure the vital signs
976 of the patient, record their chest and lung sound using a digital stethoscope [33], capture a video of their ear using
977 a digital otoscope [4], etc., if needed by the doctor prior or during a teleconsultation session. Such technology-aided
978 human intermediaries could support doctors in teleconsultations through remote, recorded physical examinations and
979 has the potential to increase the scope of telehealth in future.
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984 Moreover, the platformization of the Indian healthcare ecosystem mainly caters to a limited population of people
985 belonging to the upper- and middle-income class. Although the government's overarching goal is to platformize
986 healthcare through initiatives like Ayushman Bharat Digital Mission (ABDM) [41], a majority of the government (public)
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989 hospitals would not be able to participate as they are not equipped with appropriate digital infrastructures. As a result,
990 the low-income communities might be left out of the benefits of health platformization. For instance, in our limited
991 patient participants pool, all four participants from low-income class reported not using home phlebotomy services
992 and instead visiting government hospitals for diagnostic tests. We believe home phlebotomy services could be highly
993 beneficial for this demography especially because a majority of them are daily wage workers, and visiting a healthcare
994 unit means missing their daily earnings along with incurring expensive commute charges [5]. Therefore, while there
995 are immense opportunities for telehealth services in the future, there is an acute need for designers and policy makers
996 to rethink how health platformization could be made inclusive to the needs of a larger population, given the increased
997 smartphone penetration in low-income communities in India.
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1000 Finally, within the context of phlebotomists' digital workflows, our findings revealed that despite having an official
1001 digital platform, phlebotomists used a multitude of applications, which not only resulted in redundant workflows
1002 but also led to scattering of patient's private data (e.g., address) across applications such as WhatsApp and Google
1003 Maps. As their digitally stored data will persist and be accessible to the phlebotomist in their personal (unofficial)
1004 applications even after the house visit, it could have negative consequences on the patient's privacy. This is in contrast
1005 to the official phlebotomy application which revokes access to the patient's private data immediately after the house
1006 visit. Moreover, this results in blurred boundaries between the use of official and unofficial applications to carry their
1007 workflows [57]. We envision two opportunities for the design of future health platforms in order to mitigate these
1008 issues. First, the phlebotomist application could be designed in a way to integrate end-to-end workflows such that
1009 the phlebotomists does not require switching applications. More specifically, it could entail additional workflows like
1010 directional navigation, text messaging, provision to update the reporting manager with their location, etc. Second,
1011 organizations could exploit existing popular platforms to support phlebotomist's workflows instead of introducing a
1012 separate official application. Prior research has highlighted that users often appropriate existing platforms than using
1013 custom-built ones for conducting their workflows [24, 32, 58]. For instance, existing chat applications (like WhatsApp)
1014 could be used to power phlebotomist workflows, as communication and location sharing are key components of their
1015 work. An official WhatsApp-based chatbot could be designed where the phlebotomist could receive patient's details,
1016 provide updates of their location, send picture of the collected sample, collect payment, etc., and any private patient
1017 data could be automatically-erased at the completion of the sample collection process.
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1023 5.3 Design Implications to facilitate Home Phlebotomy

1024 We now discuss design recommendations for digital platforms offering home phlebotomy services that could facilitate
1025 secure and transparent workflows for the phlebotomists, and also foster trustworthy phlebotomist-patient relationships.
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1028 *Designing Transparent Incentive Mechanisms.* In our study, we found that all organizations adopted some form of rating
1029 mechanism to monitor the performance of their phlebotomists. Patients were requested to rate the phlebotomists (and
1030 provide feedback) in the customer smartphone application upon completion of the sample collection. Prior studies have
1031 discussed the impact of algorithmically-mediated 'rating-based reputation system' on the worker's compensation [3],
1032 and found that it compels the worker to socialize with customers in exchange of good ratings [48]. However, all
1033 (except one) phlebotomists lacked understanding of the impact of patient rating on their incentive; only one participant
1034 mentioned receiving a reduced incentive due to poor ratings, but was unclear of the calibration. Even none of our
1035 patient participants were aware of the impact of their rating on the phlebotomist's compensation. As a result, there is a
1036 need to design transparent rating mechanisms that clearly explains the impact of rating on their compensation to both
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1041 the parties. Moreover, it is important to clarify the impact of these ratings on other attributes of phlebotomists' work if
1042 any (e.g., number, type and location of assigned orders, career growth). For example, *Tata 1mg* introduced a "premium
1043 phlebotomist" feature (now taken down) which allowed patients to request for expert phlebotomists by paying an
1044 additional amount of INR 99 [1]. It is however unclear on what basis (platform rating, education, or work experience)
1045 did they categorize phlebotomists as experts.
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1049 *Designing to Elevate Phlebotomist-Patient Trust Relationship.* Our findings revealed that a common misconception among
1050 our patient participants was that home phlebotomists were less experienced than clinic phlebotomists. To promote
1051 trust for home phlebotomists, it might be helpful to communicate the steps (may be in the form of a digital checklist)
1052 involved in the sample collection procedure in advance to the patient. Seeing the phlebotomist adhering to the checklist
1053 might help in comforting the patient and elevating their trust in the phlebotomist. From the phlebotomist's perspective,
1054 we observed that existing platforms had limitations in verifying patient-entered information. For example, patients
1055 intentionally entered incorrect age of children to avail home phlebotomy. This results in home phlebotomists facing
1056 issues due to the difficulties associated with pediatric phlebotomy. Therefore, it becomes crucial to design technology
1057 for governing patient's actions and boost phlebotomist's trust in their customers. For instance, strict verification checks
1058 through identity proofs could be introduced during patient registration process to avoid incorrect patient bookings.
1059 In addition, our phlebotomists reported collecting digital evidence such as screenshots of call logs to justify their
1060 actions. For example, as per an organization's policy, the phlebotomist needs to attempt calling the patient at least three
1061 times and submit these call logs while requesting for cancellation. These manual self-logging measures for collecting
1062 digital evidence are additional workflows for the phlebotomists. Future research could develop techniques to auto-track
1063 phlebotomist-to-patient call logs and automatically share it with the reporting manager. For instance, the reporting
1064 manager could receive an automated message notifying that "*Mr. A phlebotomist tried calling Mr. B patient thrice...*" Such
1065 automated digital mechanisms could help in minimizing additional workflows undertaken by phlebotomists.
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1072 *Designing for Preserving Patients' Privacy.* Although organizations attempted to preserve privacy of both the patient and
1073 phlebotomist by masking patient's phone number in the phlebotomist application and enabling in-app calling feature,
1074 we found that phlebotomists share their phone number with the patient (over the in-app call) and request the patient to
1075 share their accurate house location over WhatsApp. Future research should focus on preserving privacy by investigating
1076 alternate ways to share location. For example, a WhatsApp icon in the phlebotomist application could request patient's
1077 location on behalf of the phlebotomist. An official WhatsApp bot could be used to facilitate this communication between
1078 the phlebotomist and the patient, thus preventing the obligatory exchange of contact numbers. The shared location
1079 could then be retrieved and updated in both the patient and phlebotomist's application. Similarly, to cancel a booking,
1080 the phlebotomist needs to submit an audio recording of their call with the patient as a digital evidence. However, we
1081 found phlebotomists recording the call without informing and/or taking consent from the patient, thus compromising
1082 the patient's privacy. Organizations should explore ethical means to record a patient's decision to cancel a booking. For
1083 instance, if the patient cancels a booking over the phone, the phlebotomist could select "*Request Cancel Confirmation*"
1084 option in their application to send a push notification to the patient. The notification asks the patient, "*Do you want*
1085 *to cancel your booking?*" with *Yes* and *No* as options. The patient's decision should be automatically shared with the
1086 reporting manager of the phlebotomist. Such a feature could help in maintaining the privacy of the patient as well as in
1087 minimizing the redundant workflows of the phlebotomist.
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5.4 Limitations

We acknowledge several limitations of this work. First, as all our participants were from Bengaluru and Delhi, i.e., 2 urban cities in India, our findings may not generalize across the country given its rich socioeconomic diversity. However, given the increasing digitization in healthcare, findings in the context of urban cities might be valuable as platformized health services gradually seep into tier-2, tier-3, and remote areas of India. Second, although we tried to interview different stakeholders in the home phlebotomy ecosystem, we were not able to interview route managers and reporting managers, due to their packed schedule as they managed and directed the workflows of phlebotomists and riders (approx 20). Finally, we acknowledge reporting limited findings from the patient and rider interviews. This might be attributed to the respective small sample sizes. Moreover, we found most of the insights from our patient and rider interviews to be either not in direct connection with phlebotomist's workflow (which is the focus of our paper), or already covered in the phlebotomist interviews.

6 CONCLUSION

To understand the home phlebotomy ecosystem in India, we conducted 26 semi-structured interviews with key stakeholders, including phlebotomists, patients, and riders, along with observational studies of 3 phlebotomists. In spite of the close resemblance between home phlebotomy work and a typical gig-work, we found key differences with respect to the social support system and compensation structure, thus envisioning a hybrid model of gig-work. The strong support network was leveraged by our phlebotomists to delegate orders, optimize earnings and share grievances. In addition, we uncovered the role of platformization as an inhibitor by location-based surveillance and redundant workflows, as well as a facilitator with the digital evidence of work safeguarding them in difficult situations. Based on our findings, we propose a future of health platformization, with the home phlebotomists intermediating teleconsultation, serving low-income community, and relying on a single platform to minimize patient data leakage risk. We also propose design recommendations to improve the transparency, trustworthiness, and confidentiality, within the phlebotomy ecosystem.

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