Worker Experience and Donor Heterogeneity: The Impact of Charitable Workers on Donors' Blood Donation Decisions

Preprint *in* Manufacturing & Service Operations Management · January 2023

DOI: 10.1287/msom.2023.1198

CITATIONS
0

READS
359

3 authors:

Wilson Lin
University of Southern California
2 PUBLICATIONS **0** CITATIONS
SEE PROFILE

Susan Feng Lu
Purdue University
49 PUBLICATIONS **1,135** CITATIONS
SEE PROFILE

Tianshu Sun
University of Southern California
41 PUBLICATIONS **467** CITATIONS
SEE PROFILE

Worker Experience and Donor Heterogeneity: The Impact of Charitable Workers on Donors' Blood Donation Decisions

Wilson Lin
Santa Clara University

Susan Feng Lu
Purdue University and Peking University

Tianshu Sun
Cheung Kong Graduate School of Business and University of Southern California

January 2023

Abstract

Problem definition: We ask whether and how a charitable organization's front-line staff members can be effectively positioned to encourage donors to donate more (in compliance with the eligibility rules) during their in-person interactions. Specifically, we consider how charitable organizations can use micro-level data on worker-donor interactions to improve donation outcomes, via understanding of workers' experiences and donors' characteristics.
Methodology/Results: Using a unique dataset at the nurse-donor interaction level, we analyze the role of nurses' experiences in driving charitable productivity and explore the downstream effects of the donation volume outcome. We find that the effect of the charitable worker on charitable productivity strongly depends on the worker's experiences which entail sharing knowledge about a donor's donation options, rather than the worker's experiences that are primarily focused on collecting donations. Moreover, nurse experience can encourage donors that have lower self-efficacy over performing their donation to choose higher donation volumes. A worker's experience with donors with lower self-efficacy furthermore benefits charitable productivity when interacting with those donors. Higher donations induced by an experienced worker from the previous session are correlated with higher donation volumes in the focal session if the donor returns to donate.
Managerial Implications: When taking the insights on staff-donor interactions into account, improved matching between nurses and donors can provide economically significant benefits for the blood bank. Understanding worker experience in the staff-donor interactions and leveraging big data in staffing decisions can help charitable organizations improve their productivity simply from the personnel end.

Keywords: charitable operations, charitable giving, nonprofit operations, data analytics, blood donation, public health

---

Acknowledgements: We significantly benefit from detailed discussions with Ginger Jin in the development of this paper. We thank Ritu Agarwal, Maria Ibanez, Diwas KC, Stefan Wager, Guihua Wang, seminar participants at the USC Marshall School of Business, and participants at POMS 2019, INFORMS Healthcare 2019, INFORMS 2019, CHITA 2020, ICSS 2020, and Workshop on AI and Analytics for Social Good for their constructive comments. Lin acknowledges the support of the Marshall Fellowship at the USC Marshall School of Business. Lu acknowledges the support of the Lyles Rising Star fund. Sun acknowledges the support of the Adobe Data Science Award and iORB grant at the USC Marshall School of Business. We also thank the staff at the blood bank that provided the data for tirelessly explaining its operations and answering our questions. This paper would not exist without their help.

1. Introduction

Charitable organizations face a challenge of retaining a steady supply of donations to deliver upon their mission. To secure a reliable donation flow to maintain their operations, charitable organizations spend significant efforts on donor recruitment and retention. For example, in the COVID-19 pandemic, blood reserves have been critically low in multiple countries and significant benefits, such as gift cards and coronavirus anti-body testing, have been offered to motivate donor donations (Marcus 2020). However, such fundraising costs are non-trivial, with "a typical charity [spending] from 5 to 25 percent of its donation on further fund-raising activities" (Andreoni and Payne 2011). Despite this fact, few efforts are spent by organizations to explore alternative sources to increase donations.

In this study, we approach this challenge by empirically investigating the value of workers in charitable organizations and how their interactions with donors may improve donation outcomes. While prior studies in operations management have examined how worker characteristics such as experience can impact outcomes like efficiency (e.g., processing time) and quality (e.g., mortality rate), to the best of our knowledge, few studies have considered the impact of such factors in a charitable giving context on organizational outcomes. There is scant literature on the worker dimension on charitable giving, with mixed evidence showing that giving charitable workers' some incentives can increase or backfire on donations (Gneezy and List 2006, Gneezy and Rustichini 2000).

Charitable giving presents two unique differences in contrast to the contexts previously studied on worker experience. First, beyond performing their tasks efficiently, staff members can influence *donation decisions (whether to donate and how much to donate)* in their donor interactions. Second and importantly, unlike most operational contexts where customers come to the organization for a service need, donors do not interact with a charitable organization in *need* for a service. Rather, donors enable the function of the charitable organization by providing their own resources for the benefit of the organization and society (List 2011). Donors represent active decision-makers regarding *how much* resources they may be willing to contribute, and may have complex motivations such as intrinsic motivation or altruism (Shi, J. Wang, et al. 2014), image/reputational motivation (Filiz-Ozbay and Ozbay 2014, Lacetera and Macis 2010), reciprocity (Bénabou and Tirole 2006, Shi, J. Wang, et al. 2014), and social pressure (Dellavigna et al. 2012). In contrast to customers or patients, donors' utility are also driven by warm glow (Andreoni 1989, 1990). As suggested by List (2011), a deep understanding of donor motivations can motivate donor actions and identify appropriate strategies. Altogether, the outcomes of an interaction between donor and charitable organization worker are driven by donors and mediated by the worker. Due to these complexities present for a donor, a charitable decisionmaker may not be able to simply apply the results from existing literature: there are additional nuances of which may alter the magnitude and possibly

direction of the effect of experience. Improving outcomes in the charitable giving setting proves economically significant, as "charitable gifts [exceed] 2 percent of gross domestic product" (List 2011).

Understanding how staffing influences productivity is important, but surprisingly, little empirical work so far has systematically studied whether and how charitable organizations could leverage workers to achieve better outcomes. The lack of research can be attributed to two fundamental challenges in measuring and identifying the effect of worker-customer interactions on outcomes, namely the attribution challenge and the causality challenge.

First, in a range of operational contexts, customer outcomes cannot be clearly attributed to her matching with a single worker. For instance, some blood banks have several nurses handling a single donor's donation experience. Moreover, when working with charitable organizations, personnel information and outcomes tied to a worker may be considered as confidential, preventing researchers to study the role of workers on outcomes.

Second, in many important contexts, the assignment of a worker to a customer is endogenous. For instance, firms often dispatch their best salesperson for highly valuable customers. Hospitals often match their best physicians to patients under risk. Drawing conclusions about the casual effect of staffing may be difficult when the matching is endogenous and involves unobserved factors. Our research context overcomes these issues with the exogenous inflow of donors to blood mobiles and exogenous matching between donors and nurses.

We study the importance of worker experiences and its interplay with donors on charitable productivity in the context of blood donation in China, where eligible donors donating whole blood can choose how much blood they would like to donate in a session—a choice of 200, 300, or 400 millimeters.[1] All of these donation choices would be safe to the donor per World Health Organization guidelines (World Health Organisation 2012), whereby donors should donate volumes that are less than 13% of total blood volume, i.e., a donor should weigh 45 kg to donate 350 ml (+/- 10%) or 50 kg to donate 450 ml (+/- 10%). Nurses—as the front-line workers in our context—assist donors to decide the donation decision amount and perform the entire service experience for the donor. Successfully encouraging donors to choose the higher amounts has immediate implications for blood supply and the healthcare system, and would increase blood supply significantly (Shi, J. X. Wang, et al. 2014).

Using unique, micro-level data involving 766,104 donation sessions at the nurse-donor level, we find that versus a new nurse, a nurse with average accumulated *voluntary donation experience* (where nurses

[1] Such a decision when making voluntary whole blood donations is also prevalent in other countries, e.g., Taiwan has options of 250 or 500 ml; Japan 200 ml or 400 ml; South Korea 320 or 400 ml. Donors may also choose between different donation options, e.g. one unit of whole blood vs two units of red blood cells in the United States.

engage with donors about the blood donation process) can obtain on average a 2.27% marginal increase in donation volume. Such effect varies by donors' self-efficacy towards blood donation. We also find that a nurse's concordant experience with specific subgroups of donors improves productivity when interacting with such donors. Moreover, donors who were encouraged by experienced nurses to donate more in a previous session tend to choose the higher donation volumes when they return to donate. We perform counterfactual analyses on improved matching schemes, which suggest that organizations can improve outcomes without incurring additional operational costs by matching workers who may be more compatible with certain donors.

This study makes contributions to the literature in three folds. First, prior studies primarily focus on donor related interventions to increase donations (e.g. Bénabou and Tirole 2006, Gneezy and Rustichini 2000, Lacetera et al. 2014, Masser et al. 2008, Reich et al. 2006, Ryzhov et al. 2016). To our knowledge, in the nonprofit management literature, there are few papers studying the charitable worker dimension. We are one of the first to provide insights on the impact of charitable workers' features on donation outcomes.

Second, we find that in contrast to for-profit settings where "overselling" by experienced workers may be a concern, inducing the highest possible option in the blood donation setting appears to be beneficial towards the donor lifecycle and organizations in the long run. Our work extends the experience literature by demonstrating the learning curve for workers holds in the charitable giving setting, where developing interpersonal relationships with active decisionmakers (donors) who are driven by warm glow is important to a nonprofit organization's success.

Third, we find that higher levels of worker experience with donors with lower self-efficacy improves a nurse's productivity during interactions with such donors. This finding extends earlier work on the benefits of concordance (Greenwood et al. 2018, 2020) towards concordance with donor self-efficacy.

Altogether, our results suggest that improved matching of workers and donors via understanding of factors that are related to worker experience and donor's charitable motives can play a cost-effective direction to improve charitable productivity for both the immediate and long term.

2. Institutional Background: Operations in the Blood Bank

We collaborate with a major Chinese blood bank in a provincial capital city with a population of more than 8 million. The blood center is responsible for supplying blood to hospitals in the city and is encouraged to equalize demand and supply of whole blood on its own.

2.1 Whole Blood Donation: Voluntary and Group Setting

Whole blood donations are challenging for the bank to recruit new donors and to motivate existing donors to donate repeatedly. This challenge can be explained due to two reasons: the first is a constraint that one can only donate blood every six months (other countries have shorter restrictions; for example, in

the United States, one can donate every 56 days), and second being cultural factors: "traditional Chinese culture holds that the loss of even a small amount of blood has a substantial detrimental effect on health. Some people also believe that donating blood is a disloyal act against one's ancestors" (Shan et al. 2002). Yin et al. (2015) notes "blood is usually compared to lifeline and carries great weight in the Chinese culture." Studies have shown that almost 70% of donations in China are made by first time donors (Guo et al. 2011, Wang et al. 2010).

The Law of the People's Republic of China on Blood Donation enforced voluntary blood donations in 1998. The law defined bounds for the amount of whole blood to be collected within a session (Article 9), that blood collection should be done in compliance of operational procedures and regulations (Article 10), and that violating such operational procedures could lead to strong consequences (Article 19). To resolve the challenge of having sufficient blood supply, Chinese blood banks began to expand upon the default option of donating 200 ml and let eligible donors decide how much blood they would like to donate in a session: 200, 300 or 400 ml (Shan et al. 2002). All of these donation choices would be safe to the donor per World Health Organization guidelines (World Health Organisation 2012), whereby donors should donate volumes that are less than 13% of total blood volume, i.e., a donor should weigh 45 kg to donate 350 ml (+/- 10%) or 50 kg to donate 450 ml (+/- 10%). Nurses help the donor decide the appropriate donation volume. This decision has operational implications to provide healthcare effectively to patients in need, and also financial implications in serving the market for blood (Slonim et al. 2014). Consequently, any opportunity to increase donation volumes to 400ml could have a significant benefit to blood supply (Shi, J. X. Wang, et al. 2014).

To further resolve demand issues with voluntary blood donation, Chinese blood banks also collect whole-blood donation under the group donation setting. This setting consists of employer/institution (e.g., universities)-organized blood drives where their members (e.g., workers, students) donate blood (Sun et al. 2016). At these blood drives, the focus is only on "group donors"; nurses assigned to these drives would hence typically only focus on one type of donor/location for the day.

The group donation setting may involve donors who are not truly volunteers, as they may specifically motivated by a third-party member that could offer other benefits/incentives (Shan et al. 2002). Moreover, the likelihood of moderating discussions on donation volume choice is lowest in this setting for two reasons. First, there is a higher throughput of donors in such setting. Second, the host organization may predetermine the donation volume and/or provide extrinsic motivation (e.g. time off work, scholarship likelihood increase for students) to encourage donations.

In contrast, voluntary donors simply walk in to donate and do not make appointments to donate blood. Once on the bloodmobile, nurses handle the entire donation experience for the donor. Hence, both the decisions on whether the donor is eligible to donate and how much the donor donates can be attributed

to the nurse. Appendix Table A1 demonstrates the differences between the donor profiles between voluntary and group donations. We see that the voluntary donation setting represents more of the city population, whereas the group donation setting is skewed towards the younger population.

2.2 Voluntary Donation: Donor and Nurse Incentives

Voluntary donors have only minor incentives for blood donation, such as gift cards/snacks after blood donation. They may also be able to receive blood donor reimbursement, as stipulated by Article 14 of the Blood Donation Law. That is, donors who donate large volumes of blood over time would not need to pay for their blood transfusions if such transfusions are needed. Family members of the donor also could benefit (spouse, parents, children) as they would be able to get blood transfusions, up to the amount of cumulative blood donated by the donor, for free.[2] Studies on Chinese blood donors suggest that donors donate primarily to help others in need (Ou-Yang et al. 2017) and not primarily due to such incentives (Yu et al. 2013).

On the nurse side, the blood bank introduced nurse-specific incentive payment schemes on March 26, 2013. Prior to this policy, nurse pay was either the same for all (before 2011/3/26) or the same within a team (2011/3/26-2013/3/25), which assigned bonuses to nurses based on their within district performance. The nurse-specific policy provides bonuses tied to the amount of voluntary donations that successfully passed blood quality tests, relative to a baseline monthly quota (specific to district but not specific to individual). Such scheme had a nonlinear payment structure and did not penalize nurses who did not meet baseline needs. We discuss the effect of incentive payment schemes in Section 6.4. All nurses were equally impacted by such incentives; moreover, all nurses are subject to first year evaluations.

2.3 Assignment of Donation Settings and Locations

Nurses in our blood bank can work in multiple settings (e.g., voluntary donation and group donation). Consequently, all settings allow nurses to gain experience with blood collection. However, the depth of the interaction between nurse and donor varies across settings, leading to different skills learned and practiced by the nurse. Nurses cannot choose their assignments between donation settings. Fairness across all teams is a major consideration by the blood bank. Nurses on average work in the voluntary setting for 80% of the days.

[2] In practice, there is a significant gap between what the blood bank promises and what hospitals could deliver. When a donor's family member needs blood, the promise is often not fulfilled, especially when the blood is in shortage in China. Some patients had relied on the family replacement program to get blood transfusion (discontinued in 2018) and others had to postpone undergoing their surgeries for a while (Sun et al. 2016). Hence, while the reimbursement method may encourage some donors to donate (while not all donors object to it), it is not the primary rationale for donation for most, and moreover would not relate to increased donation volumes in a session.

Nurses only can select which district to work in when joining the blood bank. Such choice is largely driven by which district is closest to their residence. They cannot make any location preferences within the district. The planning of the locations assigned to a particular district is done at a yearly level, and the assigned locations for each district across the years are relatively constant.

In the voluntary setting, nurses rotate through various locations within one district of the city to conduct blood donation, spending 1-2 days (median 1 day, mean 1.9 days) on average at each location; hence most nurses do not work multiple locations in a day (median 1, mean 1.04). At most locations, only one nurse works at the location for the entire day (median: 1, mean: 1.43) while occasionally multiple staff members may work at the same location during the day. The low number of staff members assigned to a location reduces the presence of peer effects that may arise when nurses communicate with one another or work together (Tan and Netessine 2019).

Nurses are assigned to group donation locations similarly as the previous discussion on nurse rotation for voluntary donations. Nurses working in a group donation location similarly work there for a median of 1 day (mean 1.1 days) prior to being switched to a different location.

These patterns allow us to assume that the different types of experience a nurse gain are largely exogenous. We address endogeneity concerns regarding nurses potentially being selected into particularly busy/higher performing locations with analyses on whether nurses with higher experience may be assigned to a busy/high volume location or may be assigned differently towards the donation settings; more details are described in Appendix Section A.1. The corresponding results, shown in Appendix Tables A4-A6, demonstrate that nurse experience does not determine location or setting allocation. We also consider whether nurse's overall experience with locations can play a role in increasing donation volumes and find that it is not the case in Appendix Table A7—rather, relevant experience is the main driver.

3. Literature Review and Hypotheses Development

Our research mainly builds on two streams of operations management literature: (1) charitable giving and nonprofit operations and (2) experience. In this section, we review the literature and theorize how organizations can leverage information about workers and donors to improve donation outcomes during worker-donor interactions.

3.1 Literature on Charitable Giving and Nonprofit Operations

Extensive research has been done on understanding donor motives and what incentives should charitable organizations offer to encourage donors to donate. Such literature has explored factors underlying donation behavior, such as social ties (List and Price 2009, Meer 2011), peer pressure and conditional cooperation (Frey and Meier 2004), and incentives (Bénabou and Tirole 2006, Gneezy and Rustichini 2000). Such literature also considers mechanisms to encourage donors to participate in blood

donation. For example, Reich et al. (2006) study a range of recruitment methods (T-shirts, phone messages and email recruitment), Lacetera et al. (2012) and Lacetera et al. (2014) monetary incentives, and Ryzhov et al. (2016) direct-mail marketing design. Sun et al. (2016) and Sun et al. (2019) evaluate mobile messages, family replacement programs and motivating offline group formation in increasing donors' blood donation activities.

In contrast to prior studies focusing on donor related interventions or the improvement of operations before or after donations (e.g., Aprahamian et al. 2019, Ayer et al. 2019, Cohen 1976, Cohen and Pierskalla 1979), we focus on the impact of charitable workers and donors on donations. To our knowledge, there is scant literature on the worker perspective, with mixed evidence showing that giving charitable workers' some incentives can increase or backfire on donations (Gneezy and List 2006, Gneezy and Rustichini 2000). We are one of the first to provide insights on the impact of charitable workers on donation outcomes. Moreover, although some studies have investigated drivers of return donations (France et al. 2008, Masser et al. 2009, Schlumpf et al. 2008), we extend these efforts, which have largely been driven by survey instruments, via an investigation of donor outcomes on future donation behavior.

More broadly, our work answers the call for focus on improving nonprofit operations (Berenguer and Shen 2019) with the lens of improving the operational efficiency of nonprofit organizations, and contributes to the increasing interest of nonprofit operations and evaluation of corporate social responsibility in operations (e.g., Kraft et al. 2018, Singh et al. 2019).

3.2 Literature on Experience

A long line of literature has documented the volume-outcome relationship. Exploring experience at both individual and organizational level, the learning curve effect has been documented in contexts like manufacturing and services (Argote and Epple 1990, Pisano et al. 2001, Valentine et al. 2019). The experience outcome relationship has been further unpacked by looking at dimensions of experience such as specialization and variety (Narayanan et al. 2009, Staats and Gino 2012) and focal and related experience (KC and Staats 2012), suggesting that experience is helpful, but some types of experience may be more helpful than others.

The existing experience literature with detailed panel data have studied tasks where there have been minimal, if any, interpersonal discussions or collaborations between the employee and the customer to fulfill the task at hand. For instance, KC and Staats (2012) study how cardiothoracic surgeons perform cardiac procedures with sedated patients, Staats and Gino (2012) study how Japanese bank workers process loan mortgages, and Boh et al. (2007) and Narayanan et al. (2009) study information technology workers efficiency in resolving software development tasks. These results suggest that practice makes perfect.

Several works have studied the role of experience in interpersonal settings. For instance, Dokko et al. (2009) uses call center agent data to consider the variable effects of certain types of experiences on knowledge and performance. They show that "task-relevant knowledge and skill mediates the relationship between prior related experience and job performance and that it acts as a suppressing mediator of a negative direct relationship between prior related experience and current job experience." These findings, however, are based on cross-sectional data rather than longitudinal data as done in our paper. Meanwhile, Podolsky et al. (2019) performs a meta-analysis which shows that experienced teachers have better student standardized test scores, and notes that a good proportion of such studies (approximately two-thirds) utilize longitudinal datasets to achieve such results.[3] In an educational space, however, the effect of experience may still be confounded by the students' ability to reach out for other resources, e.g., after-school education, which may impact their own test scores.

We would also like to highlight several related works that study the value of specific types of experiences. KC and Staats (2012) shows the importance of focal (minimally invasive CABG) versus related (related cardiac procedure) experience on mortality rates and explores the impact of subtask variety (procedures that are minimally invasive or other cardiac procedures) and firm specificity (within/outside hospital experience). Additionally, Huckman and Staats (2011) considers how diversity on customer experience in a team for software services can impact performance (e.g., effort deviation, schedule adherence, schedule deviation). We corroborate the findings in KC and Staats (2012) by demonstrating the differential value of experience accumulated across different blood donation settings. We extend Huckman and Staats (2011)'s focus on customer experience by showing the heterogeneous impacts of experience across different donor types and how experiences with particular donors impact outcomes when interacting with such donors.

All in all, it remains to be seen whether the effects of experience carry in a setting with significant interpersonal discussions and with donors who are motivated more by warm glow and are active decision makers in the interaction, which contrast traditional customers and patients who come for a service. To our knowledge, this work is one of the few papers which studies the impact of experience in a charitable setting. We find that the experience effect on donors with warm glow is different from that on for-profit customers.

3.3 Hypotheses Development

[3] Longitudinal data models were not common until recently as data availability became better. Teacher fixed effects resolve concerns about selective attrition and/or differences in cohort quality, and school fixed effects can allow for comparisons within schools. The article notes that student and school fixed effects can help partially address issues regarding random assignment.

In the voluntary donation setting, nurses play an active role in informing the donor and recommending appropriate donation volume choices as the donation volume choices are discussed more so. Donor knowledge about blood donation policies and practices is generally low (Zaller et al. 2005), and nurses can address this knowledge gap in their interactions. Most donors in the voluntary setting, especially new donors, which comprise most of the donor population, may be unaware of the decision when donating whole blood: how much to donate. If a donor is eligible to donate blood, then they can choose any of the options (200, 300, or 400 ml) as they would be safe to the donor per World Health Organization guidelines (World Health Organisation 2012). Over time, the nurse can learn how to help the donor translate their intention to donate into the appropriate enacted level of behavior (donation volume), by improving and/or confirming a donor's sense of self-efficacy: the belief on one's capabilities on exercising control on a particular event or behavior (Bandura 1977, Fishbein and Ajzen 2011).

A nurse can increase the self-efficacy of a donor with the effective delivery of codified (known facts about blood donation and its effects) and tacit knowledge (e.g., personalization of discussions with donors and understanding in-the-moment behavior) (Bandura 1977, Rodriguez Perez and Ordóñez de Pablos 2003). Such knowledge helps the donor understand the potential trade-offs with the donation volume decision: (a) to be fully altruistic in helping to provide blood for others or (b) to consider their ability to recuperate from blood loss post-donation. Some examples of providing codified knowledge as part of a nurse's verbal persuasion include "您的身体情况可以每六个月回来献血" and "您的身体条件包括体重和脉搏可以献 400 毫升", which translate as follows: "Your physical condition suggests that you can come back every 6 months to donate" and "Your physical condition, including your weight and pulse, suggests you can donate 400ml." Such phrases highlight the donor's ability to donate, which in turn can their self-efficacy towards blood donation. These phrases also summarize the vicarious experiences of other donors that have performed blood donation, which is another channel in which one may increase their self-efficacy. Knowing when to say such phrases, however, is an example of tacit knowledge. For instance, it may not be necessary to mention such statements to donors if they have a history of donating 400 ml, or if they already signaled that they want to donate the most blood possible. Moreover, nurses may gain tacit knowledge on how a) encourage donors who are not eligible to donate due to idiosyncratic and temporal reasons (e.g., come back from abroad recently, had alcohol recently) to come back to donate as soon as possible and b) identify high risk donors based on their behavior and survey results and flagging them in the system. Such knowledge can help the nurse better moderate their discussions with a donor.

In summary, accumulating experience in this modality helps strengthen nurses' ability to share codified knowledge, but most importantly, bolster their tacit knowledge. Such knowledge can strengthen the nurse's verbal persuasion (Bandura 1977) to increase the donor's self-efficacy. Experience is

ultimately something that the central blood bank can influence to improve operations via nurse-location assignment as part of staffing decisions, as different locations largely belong to one specific donation setting. Taken together, we hypothesize:

> **Hypothesis 1**: A nurse's experience with voluntary donations is positively associated with a higher donation volume choice.

In contrast, the other settings involve nurse-donor interactions where there is less discussion on donation volume. Hence, individuals do not get to fully undergo the decision process regarding donation choice. Experience gained in these settings therefore serves to primarily reinforce codified knowledge (blood collection and its impact), but not build upon tacit knowledge on helping donors enact the appropriate level of behavior (donation outcome). One could argue that such experience is a related task and therefore may be helpful in improving donation volume outcomes (KC and Staats 2012), as the skill set that a nurse needs for these donors is a proper subset of the skill set needed for voluntary donors. The experience gained in other settings may not increase donation volume outcomes to the extent that voluntary donation experience would. Hence, we hypothesize:

> **Hypothesis 2**: A nurse's experience with voluntary donations is more salient than other experiences on donation volume choice.

Next, we examine the heterogeneous effects of voluntary donation experience on different types of donors. Although all donors, by virtue of coming to the blood bank, have signaled that their beliefs associated with blood donation have guided them to intend to perform the act of blood donation, donors may have different notions of self-efficacy (Bandura 1977, Fishbein and Ajzen 2011)—a significant predictor for blood donation intentions (Masser et al. 2008).

Moreover, donors may derive warm-glow from donation, with the majority of blood donors being altruistic (Ou-Yang et al. 2017). For these donors, *higher amounts of donation would bring substantially more utility* (Andreoni 1989, 1990) as 300 and 400 ml represent significant increases to the baseline 200 ml, despite all options being safe to donate for an eligible donor. *Voluntary donation experience* gained with seeing how donors make these decisions can allow the nurse to mediate a donor's self-efficacy and subsequent donation choice, by informing them how to best heighten donor's sense of control and activate their warm glow. For donors who have high self-efficacy, the effect of voluntary donation experience may be less salient. On the other hand, for donors with lower self-efficacy, the nurse could have more opportunity to heighten their sense of control. We consider three dimensions that are associated with lower self-efficacy: donor status, gender, and weight.

New donors are likely new to blood donation in general. Hence, more time may be needed for such donor to process the donation experience and decisions that need to be made. In contrast, Veldhuizen et al. (2011) finds that self-efficacy increases with donors that have additional donation history, suggesting

that "the more donation experience a donor has, the more motivated he or she becomes to donate again. The donation experiences feed back into donation intentions, making the motivation to donate more salient" (p. 2432). They also find that "at different stages of the donor career path self-efficacy emerges as the key predictor in relation to donation motivation" (p. 2433). In other words, existing donors have the information of their previous donation experience—within session and post-session recovery—to inform their future decisions. Hence, we conjecture new donors are more likely to be influenced by nurses when making the volume decision compared to existing donors. This leads to the following sub-hypothesis:

> **Hypothesis 3a:** The effect of nurses' voluntary donation experience on donations is more salient for new donors.

Second, we consider gender, as France et al. (2008) finds that self-efficacy matters more as a predictor for blood donation for women versus men in a study of experienced donors. Moreover, Bani and Giussani (2010)'s review of the role of gender in blood donation highlights that female donors show greater altruism compared to males, and hence may respond more to efforts that activate their warm glow. However, adverse reactions may be more prevalent in women, which may lead women to not become regular donors (Bani and Giussani 2010). As females are more risk averse than males (Croson and Gneezy 2009), the higher presence of adverse reactions may further reduce their self-efficacy towards blood donation. Ou-Yang et al. (2017) finds in their survey of individuals living in Guangzhou, China that female donors find responses to questions and enquiries on their physical conditions to be a more important service component than males (70.9 vs 60.6%, p=0.02). These observations on female donors suggest that self-efficacy over the donation action is a larger concern for females and suggest that the role of the nurse may be more salient. Hence, we hypothesize:

> **Hypothesis 3b:** The effect of nurses' voluntary donation experience on donations is more salient for female donors.

Third, we consider weight, which is a factor in donation eligibility as weight is correlated with the amount of blood that one has in the body. Although all three choices of donation volumes are safe if one meets the eligibility criteria, individuals of lower weight may be closer to the minimum weight threshold and hence feel less comfortable about donating higher donation volumes. Indeed, Hu et al. (2019) observes that weight increases in the blood donor population parallels with increased donation volume in Zhejiang province and emphasizes that such donors may have lessened impact of blood donation on the body as they would have higher blood volume. Nurse experience can play a role in helping lower weight donors increase their self-efficacy on donating the higher options. Hence, we also hypothesize:

> **Hypothesis 3c:** The effect of nurses' voluntary donation experience on donations is more salient for low-weight donors.

4. Data and Empirical Strategy

4.1 Data Description

Our dataset includes whole blood donation records from 2005/1/1 to 2017/07/04, tracking the exact time, location, donation format, donation amount (200 ml, 300 ml, or 400 ml) and quality ("pass" or "fail") of donation, the nurse identifier for the nurse that performed the donation, as well as the donor's age, gender, blood type, marriage status, education, weight, pulse, and blood pressure at the time of donation. The blood center carefully removes all identity-related information and identifies each donor (nurse) by a unique, scrambled donor (nurse) ID, allowing us to follow the donation (collection) behavior of each donor (nurse) over time.

Starting with the full dataset of donations (766,104 records), we generate the measures of interest (described in Section 4.2). Afterward, we filter for voluntary donations only, which comprise 55.9% of the original sample. We focus on donation records that take place at locations that have collected blood for over 30 days (excluding 2,536 donations (0.05% of all voluntary donations)), as locations that have few days in operation may represent one-off, non-standard operations. To resolve the left censoring issue regarding nurse experience and donor donation history, we remove all observations associated with nurses who started working before July 1, 2005 (i.e., the first 6 months of the dataset) corresponding to 157,915 donations (20.6% percent of voluntary donations) performed by 36 nurses (out of 108 nurses originally). Next, we drop records where the donation record appears to have some data entry issues (i.e., the blood pressure, pulse, age, time of donation do not appear to be in normal ranges) or the donation volume is unusual (i.e., not 200, 300 or 400). We drop the unusual donation volumes (which form very few records in our dataset), for it cannot be fully determined from the data whether these outcomes may have occurred due to donor reluctance to donate blood during the session (which would be relevant) or due to an inability to provide blood (an exogenous shock). 4 nurses with singleton observations in the remaining records are also dropped. Our main analyses hence consist of 267,941 records from 68 nurses.

Additionally, we have aggregate level results on donor satisfaction surveys which are run by the blood bank. The description of such surveys is described in Appendix Section A.2. The high satisfaction demonstrated by patients over time in such surveys, alongside the stated compliance with operational procedures and medical guidelines by the Law of the People's Republic of China on Blood Donation, help corroborate that taking a supply-side approach to improving charitable productivity could be feasible per World Health Organization guidelines (World Health Organisation 2012) and be beneficial.

4.2 Measures

4.2.1 Outcome Variables and Explanatory Variables

We measure charitable productivity as the *donation volume* achieved by a nurse during a nurse-donor interaction session. *Voluntary donation experience* is measured as the number of voluntary donations the

nurse has performed up to the focal donation, while *total experience* considers the number of donations across all settings performed up to the focal donation. In our analyses, we perform a log(*variable* + 1) transformation to consider non-linearities in the variable and account for high standard deviation for both variables. This also allows us to consider the learning curve that suggests that learning tends to be more prominent initially and limited later. To compare the value of different experiences, we construct *percentage voluntary donations*, computed as the ratio of *voluntary donation experience* divided by *total experience* and hence ranges from 0 to 1.

Summary statistics and correlations of variables of interest in the main manuscript are shown in Table 1. Additional summary statistics are available in Appendix Table A2 and A3.

4.2.2 Control Variables

We control for a range of observable donor demographics, including gender (a binary variable to indicate male or female), the age of the donor (modeled as a linear term), education level (a factor variable with the following levels: 9 years (less than high school), 12 years (high school), 16 years (undergraduate), 18 years (graduate), and Other), blood type (A, B, AB, O), and marriage status (a binary variable to indicate married or single). We also control for health indicators including weight, systolic blood pressure, and pulse, all of which can affect the recommendation on whether to donate blood and how much blood to donate; these are modeled as continuous variables. We create a factor variable to control for *the donor's previous number of donations with the blood bank within our sample (0, 1, 2 ….,10 or more),* with 0 as the base category. We also create a factor variable to control for *previous interactions that the nurse may have had with the donor (0, 1, 2, 3 or more),* with 0 as the base category.

4.3 Identification and Specification

We leverage the largely exogenous pairing of nurses and donors to identify the effects of experience. As noted in Section 2, nurses cannot choose which donation setting they work in, and are shuffled throughout locations within the district they have decided to work in. We can rule out the potential selection of donors by nurses, as nurses' recruitment of donors outside of the bloodmobile is a rare phenomenon. Instead, nurses typically stay on-board the bloodmobile to wait for donors to walk in. As donation rates are generally low in the population, the "conversion rate" of donors directly from the street by nurses is also extremely low, even if nurses exert effort and if lots of people pass by a certain bloodmobile during a day. It is hard to detect whether a passerby may be willing to donate. Moreover, during our study period, donors did not have the ability to schedule their blood donation session. Instead, they simply walked on to the bloodmobile of their choice and could not choose a particular nurse to conduct their donation. The lack of appointments lessens the certainty of donor flow at a location at a

specific time and makes it unlikely for a donor to interact with a particular nurse multiple times (if they donate repeatedly).[4]

Due to the reasons stated earlier and the fact that one nurse conducts the entire service experience with the donor, from registering the donor to collecting their blood if eligible, we can cleanly attribute the nurse's effect on donation volume choice.

$$DONATIONVOL_{ijmt} = \beta_0 + \beta_1 \log(VoluntaryExp_{it}) + \beta_2 X_{jmt} + \theta_i + \theta_m + \theta_t + \epsilon_{ijmt} \quad (1)$$

We test our hypotheses by estimating a multivariate fixed effects regression model (Equation (1)) that predicts the donation volume outcome in an individual session. To test the value of voluntary donation experience (Hypothesis 1), we run (1), which relates the dependent variable $DONATIONVOL_{ijmt}$, the donation volume outcome for a nurse i and donor j at location m during time t, to the independent variable log(*voluntary donation experience*). This specification controls for: 1) donor characteristics (X_{jmt}), which can affect the donation volume choice, 2) nurse fixed effects (θ_i), which control for time-invariant characteristics of nurses, 3) location fixed effects (θ_m), which address any environmental characteristics or differences in donor populations at locations, and 4) time fixed effects (θ_t), including hour of day, day of the week, and month-year fixed effects. We do not include donor fixed effects in our main model as a large proportion of donors in our dataset do not return to donate again. We cluster the standard errors by nurse and location (reghdfe command in Stata).

To test the relative value of voluntary experience (Hypothesis 2), we consider a nurse's total experience (*log(total experience)*) and depth in voluntary blood donations (*percentage voluntary donations*) in the following regression model:

$$DONATIONVOL_{ijmt} = \alpha_0 + \alpha_1 \log(Total\ Experience_{it}) + \alpha_2 Pct\ Voluntary_{it} + \alpha_3\ X_{jmt} + \theta_i + \theta_m + \theta_t + \epsilon_{ijmt} \quad (2)$$

X_{jmt}, θ_i, θ_m, and θ_t are defined as previously noted for Equation (1).

To explore the heterogeneous effects of voluntary donation experience with donor self-efficacy (Hypotheses 3a, 3b, 3c), we add into Equation (1) an interaction term for a particular donor characteristic with log(*voluntary donation experience*) while continuing to include the donor characteristic as a main effect. The controls for these models follow those described for Equation (1).

[4] We observe in the data that while returning donors (defined as those who make more than one donation in our study period) tend to return to the same location over our study period, with 68.2% of donors making a repeat visit to the same location at some point in our study period (but only 18.8% of donors go to the same location as their previous donation), an overwhelming 87.4% of donors who do make multiple donations never interact with the same nurse again. The probability that a donor interacts with a nurse again conditional on the day's staffing is 4.5%; conditional on the location-day's staffing, it is 8%, and donors have a 1.6% chance of interacting with the same nurse in their immediate next donation.

Table 1: Summary Statistics and Correlations of Variables of Interest

Stats	N	Mean	SD	1)	2)	3)	4)	5)	6)	7)	8)	9)	10)
1) Donation Volume	267,941	360.1	57.8	1									
2) Log(Voluntary Donation Experience)	267,941	7.7	1.2	0.0416*	1								
3) Log(Total Experience)	267,941	8.2	1.2	0.0399*	0.9851*	1							
4) Percentage Voluntary Donations	267,941	0.6	0.1	-0.004	-0.1917*	-0.3516*	1						
5) Log(Voluntary Donation Experience _ New Donor _ last 3 months)	267,941	5.1	0.6	0.0282*	0.3517*	0.3156*	0.0866*	1					
6) Log(Voluntary Donation Experience _ Female _ last 3 months)	267,941	4.6	0.6	0.0265*	0.3786*	0.3461*	0.0569*	0.9536*	1				
7) Log(Voluntary Donation Experience _ Low Weight _ last 3 months)	267,941	4.8	0.7	0.0232*	0.3498*	0.3127*	0.0931*	0.9744*	0.9798*	1			
8) New Donor	267,941	0.7	0.5	-0.1576*	-0.0276*	-0.0305*	0.0267*	0.0371*	0.0158*	0.0290*	1		
9) Female	267,941	0.4	0.5	-0.2156*	-0.001	-0.0014	0.0046	0.0066*	0.0232*	0.0181*	-0.0059*	1	
10) Low Weight	267,915	0.5	0.5	-0.3487*	-0.0151*	-0.0183*	0.0247*	0.0257*	0.0311*	0.0381*	0.0776*	0.5330*	1

*Notes: The summary statistics are calculated on a sample size of N = 267,941, besides low weight and the correlation matrix (N = 231,915). Significance: * p<0.01. Voluntary Donation Experience is measured as the number of voluntary donations performed by the nurse since joining the blood bank and before the donation session. Total Experience is measured as the number of donations performed by the nurse since joining the blood bank and before the donation session. Percentage Voluntary Donations is the ratio between Voluntary Donation Experience and Total Experience. Voluntary Donation Experience __ Donor Type __ last 3 months is measured as the number of voluntary donations with the denoted donor type which were performed by the nurse in the 3 months prior to the focal donation session. New Donor is a binary variable that equals 1 if the donation is the first observed donation for a donor's id. Female is a binary variable that equals 1 if the donor's gender is female and 0 if the donor's gender is male. Low Weight is binary variable that equals 1 if the donor has a median or lower weight (≤64 kg) in the entire donation level data.*

5. Results

5.1 The Effect of Worker Experiences

Table 2: The Impact of Voluntary Donation Experience on Donation Volume Decisions

	Dependent Variable: Donation Volume			
VARIABLES	(1)	(2)	(3)	(4)
Log(Voluntary Donation Experience)	1.342***	1.403***		
	(0.296)	(0.371)		
Log(Total Experience)			1.456***	1.500***
			(0.276)	(0.357)
Past Percentage Voluntary Donations			13.586***	12.931***
			(2.891)	(3.106)
Constant	346.064***	227.970***	334.297***	216.844***
	(6.616)	(12.197)	(7.212)	(12.934)
Observations	267,941	231,610	267,941	231,610
R-squared	0.047	0.225	0.048	0.226
Donor Controls	No	Yes	No	Yes
Nurse Fixed Effects	Yes	Yes	Yes	Yes
Location Fixed Effects	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes

Robust standard errors in parentheses, clustered by nurse and location
*** p<0.01, ** p<0.05, * p<0.1

Table 2 shows the results for how voluntary donation experience impacts resultant donation decisions. Columns (1) and (2) provide support for Hypothesis 1, with the coefficient of log(*voluntary donation experience*) being positive and significant. Columns (3) and (4) compare the relative value of voluntary experience. Further supporting Hypothesis 1 and showing support for Hypothesis 2, we observe that experience overall is helpful, but the percentage of such experience that is done in the voluntary setting serves to further increase donation volume.

Interpreting the coefficient for log(*voluntary donation experience*) on Column (2) suggests that a 10 percent increase in voluntary donation experience is associated with a 0.037% (=1.403*log(1.10) / 360.7) increase in mean productivity per donation. To put this in more concrete terms, comparing a very new nurse (i.e., performed 10 voluntary donations) to average nurse (3444 voluntary donations) we see a 1.403 x log(3444/10) = 8.20 ml increase or 2.27% marginal increase in donation volume per donation, demonstrating that more experienced nurses on average can benefit the blood bank more than a newly hired nurse. Nurses on average perform about 1000 voluntary donations in a year. Comparing the yearly trajectory of a newly hired nurse with 10 voluntary donations versus one with one standard deviation above the mean (6,432 voluntary donations), our model predicts that the more experienced nurse would obtain an additional 4,036 ml of blood, where the benefit from nurse experience for the experienced nurse is an additional 12,407 ml of blood and for the new nurse, 8,371 ml of blood. Such amounts are aligned with two days to a week's worth of additional voluntary whole blood collection.

Table 2 suggests that gaining the relevant type of experience—that is, voluntary donation experience—is important to increase outcomes within a session and overall productivity. Other experience types are less beneficial in improving charitable productivity in the voluntary donation setting.

5.2 The Heterogenous Effect of Experience by Donor Self-Efficacy

Recall that Hypotheses 3a-3c hypothesize that new donors, female donors, and lower weight donors may be more impacted by voluntary donation experience. To operationalize the difference between donors of different weight, we identify a "low weight" donor as having a weight less than or equal to the median donor weight in the entire dataset (64 kg), and "high weight" donor as above the median donor weight. We test these hypotheses by running regressions interacting *log(voluntary donation experience)* with the indicator variable identifying such donors (new donor, female, or low weight). To support Hypothesis 3a, 3b, or 3c, we expect the corresponding interaction effect to be positive and significant.

As model-free evidence, Appendix Table A2 shows the average donation volume and standard deviation of donation volume for donors of differing characteristics. We find that new, female, and lower weight donors exhibit a lower average donation volume and a higher standard deviation compared to their respective counterparts. This suggests that these groups may generally perceive lower self-efficacy and hence donate less amounts of blood, while the higher standard deviation suggests that there may be more room for nurses to help donors feel comfortable with enacting the higher donation volumes.

Table 3: The Heterogeneous Effects of Voluntary Donation Experience on Donor Groups for Donation Volume Decisions

	Dependent Variable: Donation Volume		
VARIABLES	(1)	(2)	(3)
Log(Voluntary Donation Experience)	0.889*	1.026**	1.074**
	(0.482)	(0.383)	(0.408)
New Donor	-21.843***		
	(3.328)		
New Donor x Log(Voluntary Donation Experience)	0.782*		
	(0.401)		
Female		-3.634	
		(2.231)	
Female x Log(Voluntary Donation Experience)		0.909***	
		(0.278)	
Low Weight			-38.079***
			(2.382)
Low Weight x Log(Voluntary Donation Experience)			0.806**
			(0.370)
Constant	212.011***	230.997***	339.619***
	(12.077)	(12.694)	(13.946)
Observations	231,610	231,610	231,610
R-squared	0.223	0.225	0.194
Donor Controls	Yes – variables for donation history are excluded	Yes	Yes – excludes continuous weight measure
Nurse Fixed Effects	Yes	Yes	Yes
Location Fixed Effects	Yes	Yes	Yes

Time Fixed Effects	Yes	Yes	Yes

Robust standard errors in parentheses, clustered by nurse and location
*** p<0.01, ** p<0.05, * p<0.1

Table 3 shows how new donors, female donors, and low weight donors respond to voluntary donation experience. Columns (1) to (3) show that the interaction coefficient for new donors, female donors, and lower weight donors with voluntary donation experience is positive and significant. These results suggest donors with less self-efficacy could be encouraged to donate more when paired with a nurse with greater voluntary donation experience, supporting Hypotheses 3a, 3b, and 3c. Hence, if a location may be forecasted to have more of these types of donors, it would be more salient to have nurses with high voluntary donation experience to assist in these donors' blood donation experiences.

5.3 The Value of Donor Concordant Experiences

Research on concordance of providers and patients suggest that gender (Greenwood et al. 2018), sex (Wallis et al. 2022) and racial/ethnic (Greenwood et al. 2020) concordance, specifically between providers and patients, could play a beneficial role in reducing patient mortality. Racial/ethnic and gender concordance has also been shown to impact patient experience ratings (Takeshita et al. 2020). Given that concordance within a particular interaction appears to improve outcomes, we may expect that such concordant interactions may offer learning opportunities for a worker to improve their performance. Hence, an accumulation of concordant interactions – which we will call *concordant experience* – may improve outcomes, especially if the concordant interactions occurred recently. Greenwood et al. (2018) explores this idea and finds that male physicians who gained more experience working with female patients within the last 3 months or year would lead to improvements in survival for female patients. Meanwhile, Greenwood et al. (2020) finds that the effects of racial concordance (specifically, Black newborns and Black physicians) in reducing mortality are larger in hospitals that in a particular quarter manage more Black newborns. In both studies, the benefits of concordance arise for the subgroup that may otherwise have worsened outcomes. In our context, the reduced donation outcomes arise from the donors with lower self-efficacy. Consequently, we may expect that concordant experiences with donors with lower self-efficacy will improve outcomes with those donors. Following our analyses for Hypothesis 3a, 3b, and 3c, we continue to focus on new donors, female donors, and low weight donors for donors with lower self-efficacy towards blood donation.

We take inspiration from Greenwood et al. (2018) and measure concordant experience using *voluntary donation experience _ donor type _ 3 months*, which represents the number of voluntary donations the nurse has performed with the particular donor type of interest in the last 3 months prior to the focal donation. Our model specification to test the value of concordant experience and its relationship with donors with lower self-efficacy is like Equation (1) but instead of log(*voluntary donation experience*) we include log(*voluntary donation experience _ donor type _ last 3 months*), the indicator

variable of the donor type, *FocalDonorType*, and their interaction as the main explanatory variables. Following Greenwood et al. (2018)'s specification, we control for *nurse tenure*, modeled as the number of years (partial years permitted) that a nurse has been performing blood donations at the blood bank.

Table 4: The Value of Donor Concordant Experiences

	Dependent Variable: Donation Volume		
VARIABLES	(1)	(2)	(3)
Log(Voluntary Donation Experience _ New Donor _ last 3 months)	-0.259		
	(0.641)		
New Donor	-26.195***		
	(3.900)		
New Donor x Log(Voluntary Donation Experience _ New Donor _ last 3 months)	2.018***		
	(0.728)		
Log(Voluntary Donation Experience _ Female _ last 3 months)		0.628	
		(0.435)	
Female		-2.226	
		(2.868)	
Female x Log(Voluntary Donation Experience _ Female _ last 3 months)		1.193**	
		(0.551)	
Log(Voluntary Donation Experience _ Low Weight _ last 3 months)			0.447
			(0.511)
Low Weight			-38.327***
			(2.569)
Low Weight x Log(Voluntary Donation Experience _ Low Weight _ last 3 months)			1.331**
			(0.556)
Nurse Tenure	-2.499	-3.112	-4.790
	(6.601)	(6.488)	(6.644)
Constant	254.553***	277.417***	407.716***
	(80.051)	(78.591)	(80.092)
Observations	231,610	231,610	231,610
R-squared	0.223	0.225	0.194
Donor Controls	Yes -No Past # or History	Yes	Yes - No Continuous Weight
Nurse Fixed Effects	Yes	Yes	Yes
Location Fixed Effects	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes

Robust standard errors in parentheses, clustered by nurse and location
*** p<0.01, ** p<0.05, * p<0.1

Table 4 shows that there exist non-trivial benefits of concordant experience with new, female, and low weight donors. These donors donate more when they are paired with a nurse who higher concordant experiences with the donor type recently. In line with some of the findings from the concordance literature, the main effects of the concordant experiences are insignificant (though positive in Columns (2) and (3)), suggesting that the concordant experiences are most beneficial for groups where discordance may not necessarily benefit outcomes. Following Greenwood et al. (2018), we also show in Appendix Table B3 that these results are robust to an alternative specification for *voluntary donation experience _ donor type _ 3 months* whereby the lookback time window is 1 year, instead of 3 months.

6. Robustness Checks

Our results are robust to alternative measures, specifications and competing hypotheses.

6.1 Alternative Measure: Experience Computed without Problematic Donations

Though we perform sample restrictions to identify the effect of experience, we do not restrict any donations when computing the experience measures. Our results may be positively biased if experience is computed only on donations that were included in the final sample. Appendix Table B1 demonstrates that indeed, the results may be positively biased when experience is computed without the donations that were dropped during the sample selection process. Though the results are similar for Hypothesis 1 (Columns (1) and (2) of the table), for Hypothesis 2 (Columns (3) and (4) of the table) we see that the magnitude of the effect of *past percentage voluntary donations* appears to be larger.

6.2 Alternative Measure: Days Worked

Instead of measuring experience by the number of donations performed by the nurse, we consider the number of days the nurse has worked overall and in the voluntary setting. These measures increment by one for each day when a nurse obtains one or more donation across all settings and the voluntary setting. Appendix Table B2 shows that this alternative measurement also leads to similar results for Hypotheses 1 and 2.

6.3 Analysis on Group Donors

Voluntary donation experience, alongside experiences of other donation settings, is not likely to affect other donation formats' donation volumes, especially when donors have limited opportunities to decide how much they want to donate. This generally holds true in the other format of whole blood donations—group donations (where there is higher number of donors and limited or no time to discuss donation volume options).

We perform a placebo test to see whether voluntary donation experience or total experience may necessarily benefit group donors. We also verify whether *group donation experience*—the number of donations performed by the nurse in the group donation setting prior their focal donation—may have any impact; it should not, given the setting's emphasis on blood collection only. We run the similar specifications as we did for Hypothesis 1 and 2 (and include *group donation experience* as an independent variable in separate regressions) on a different sample: group donors only. Appendix Table B4 shows that there are no significant effects of experience on this sample.

These results provide additional evidence to support the hypothesized mechanisms on nurse-donor interaction and further illustrate the role of voluntary donation experience on benefiting interactions where there is room to impact donation volume. Moreover, they corroborate the institutional details on the different donation formats and highlight the unique experience needed for voluntary donations. If

donations should be primarily coming from the voluntary format, then nurses should gain more experience in it to further organizational outcomes.

6.4 Alternative Explanations

First, a potential confounding factor is that nurses may exhibit peer effects on one another if there are multiple staff members working with one another (Tan and Netessine 2019). Nurses may benefit differentially on how to persuade donors depending on whether peers are available to discuss their work and/or encourage each other during their workdays. As a result, nurses may perform differently depending on whether they work alone or with their peers. To alleviate this concern, we create a variable that indicates whether a location-day only had one staff member performing active blood collection. We interact this variable with *voluntary donation experience* to see whether nurses may be differentially influenced when working alone versus working with peers. Column (1) in Appendix Table B5 suggests we do not find differential impacts of peer effects with voluntary donation experience. We also perform subsample analyses for donations performed by nurses working alone versus working with peers and find similar results for voluntary donation experience in Columns (2) and (3) of Appendix Table B5.

Second, we explore whether our results may be driven by certain nurses via subsample analysis. We check whether nurses who have the most experience may be driving outcomes by choosing a more restrictive cutoff month for the start of our analyses—October 2005 or January 2006—instead of July 2005. Columns (1)-(4) in Appendix Table B6 demonstrate that our results are still robust to this subsample check. One may wonder whether nurses who may have good performance (high donation volumes) and left the blood bank (potentially due to promotions) may also be driving the results. To check on this, we subsample away nurses who "left" before 2017 (as defined as not having performed any donations in 2017). Columns (5)-(6) in Appendix Table B6 report the regression results and demonstrate that our effects are still present. Altogether, these analyses suggest that our effects are not being driven by nurses who have left the blood bank, with learning still being relevant for active nurses.

Third, a concern could be that experimental interventions performed by the blood bank, such as those reported in Sun et al. (2016) and Sun et al. (2019), could have an impact on our results. To alleviate the concern that the interventions are not driving the results, we re-estimate our models to exclude the data periods that align with the experimental interventions that occur in those papers. Our main results remain to be robust as shown in Columns (7)-(8) of Appendix Table B6.

Fourth, our main specification utilizes a linear regression specification, but a discrete choice model specification may be preferred as our donation volume outcomes are discrete. Hence, we re-run the models which test our main hypotheses using multinomial logit specifications. Due to the lack of convergence of this model when using our full set of fixed effects (location, nurses, donor history, interactions with the nurse, time fixed effects), we estimate the model with the main experience variables,

nurse fixed effects, location fixed effects, time fixed effects (month, year, hour, day of the week), and donor characteristics; we model the donor's donation history (overall and with a nurse) as continuous variables instead of categorical variables. Appendix Table B7 reports the results in terms of relative risk ratios using 200 ml as the base category. We observe similar insights as we do from Equations (1) and (2).

6.5 Incentives

Section 2 mentioned that performance pay incentives were implemented at the blood bank. These incentives may influence nurses to obtain more blood in a session, as their pay would be tied to the amount of qualified blood collected. Although our main models control for month-year fixed effects, which should also largely control any effects that may be recorded from the incentive schemes, it is of interest to understand whether such worker-side incentives may potentially explain away our findings. Moreover, it is also interesting to understand whether performance pay incentives may necessarily improve charitable productivity.

To explore this matter more closely, we control for the presence of such incentive schemes in our models as follows. We create a factor variable to distinguish the exact date in which either fixed wage (prior to 2011/3/26), group pay (between 2011/3/26-2013/3/25) or individual pay (2013/3/26 onward) was implemented, with the base category set as the fixed wage. We then include this variable as an additional variable in our primary regression models on the same set of observations analyzed in our primary analyses. Columns (1)-(2) on Appendix Table B8 suggest that having explicitly controlled for the presence of incentives, Hypotheses 1 and 2 still hold. They also suggest that there is a significant positive effect of the individual pay incentive on donation outcomes. We also perform a subsample analysis on donations prior to March 2013, as the individual incentive seems to have significantly boosted donation volume. We find our results for Hypotheses 1 and 2 are robust in Columns (3)-(4) of Appendix Table B8.

Additionally, we consider whether such incentives, as well as experience, may impact the quality of blood donation. We run regressions regarding pass rates of blood donation on donation volume, experience, and incentives, while controlling for donor characteristics, nurse and location fixed effects, and time related controls as in Equation (1). We find no relationship between our main experience variables and pass rates (which generally are very high to begin with) in Appendix Table B9.

We acknowledge that the estimates regarding the effect of incentives are not necessarily causal; they are pre-post analyses. Nonetheless, they suggest that there may not be a backfiring of incentives on donation outcomes in a nonprofit setting (e.g., as seen in Gneezy and Rustichini 2000).

6.6 Workload

As empirical studies have shown that workload can influence outcomes via a speed-up effect (e.g., Berry Jaeker and Tucker 2017, KC and Terwiesch 2009, Tan and Netessine 2014), which may reduce

productivity, we consider whether workload may impact outcomes in our setting. We define a nurse's *workload* at the current donation session as the number of donors that have been registered by the nurse in the last 60 minutes before the current donation session. To reduce the presence of outliers, we top-code this variable at the 99th percentile.

Unlike the other settings like hospitals where nurse workload is very high, workload for nurses in the blood donation setting is relatively low. We calculate an approximate average utilization for the day by noting the average interarrival time and the daily number of staff members working that day and assuming a touch time/service time of 20 minutes with a donor (for pre-registration, discussing donation volume choice, and blood collection tasks (excluding observation time during collection and post collection)). We observe that average (median) daily utilization across all locations is sufficiently low at 52.5% (33.1%).

Moreover, workload in our context is exogeneous. There is no appointment system available at the time of the study, so donor arrivals cannot be smoothed out over time. This is unlike studies of workload in healthcare settings, where workload has been considered as the total of patients planned for arrival and patients in the current unit meeting a threshold (as in KC and Terwiesch 2012). Hospitals can divert and turn away patients given existing load. In the blood donation context, donors arrive as they please, and only do not receive service if they do not meet the eligibility guidelines. Given that nurses typically work alone, they do not have much of an ability to "gatekeep" had they been under high workload. Hence, an OLS analysis should be sufficient to understand the workload effect in this setting.

Appendix Table B10 shows the results of including the workload variable as a control variable. We find that Hypotheses 1 and 2 are still supported, with a positive and significant effect of *log(voluntary donation experience*) (or *log(total experience)* and *percentage voluntary donations*).

7. Managerial Implications for Nonprofit Operations

7.1 Back of the Envelope Calculation on Potential Benefits of Alternative Matching

We now perform a series of counterfactual estimates to understand the potential benefits of using the insights from our empirical results to match nurses and donors for improved outcomes. To illustrate the potential benefits, we utilize donation records in the 2011 1st half to perform counterfactual estimates.

We perform two types of counterfactual estimates. The first tries to understand the effect of pairing nurses and donors individually without considering resource constraints to see an upper bound to the value of improved matching. Such system may be implemented if organizations have an appointment system that could dynamically incorporate information to improve staffing decisions. The second considers matching of existing nurses to locations each day, which parallels the blood bank's practice of scheduling nurses. We also consider the second type of estimate with the assumption that a nurse fully

specializes in voluntary donation experience versus also working in other donation settings. Our methodology and results are described in Appendix C; we briefly report key results here.

We find that if we can pair nurses and donors individually without considering resource constraints, there is a lift to total donation volume gained of 293,490 ml. This is equivalent to approximately 1,467 additional units of blood (a unit being 200 ml); in other words, the alternative matching achieves 52% of the potential gain (defined as the additional blood collected had everyone donated 400ml), or a 5.1% increase on the existing blood collected. Had we considered resource constraints, we see that the generated donation volume is equal to 5,762,440 ml, or a 45,440 ml increase in donated blood. This amount achieves 8.05% of the potential gain, which is equivalent to an additional 227 units of blood. Considering resource constraints and the possibility that nurses were instead fully specialized in voluntary donations, there would be a 9.32% of the potential gain achieved.

7.2 The Impact of Induced Donation Volume on Return Decisions and Returning Donation Volume

Understanding drivers of donors who return to donate has been highlighted by Landry et al. (2010) as an important research direction for practice, policy, and theory. In this section, we consider how the induced donation volume from a donor's session and the nurse's experience from the corresponding session 1) impacts the donor's propensity to return to donate and 2) if the donor does return, the potential impacts on subsequent session's donation volume.

Anecdotal and model free evidence suggests that people who tend to donate higher amounts tend to return and continue to donate the higher amounts in future donations. This may happen due to two reasons. First, blood donors are motivated by warm glow (Ferguson et al. 2012), and an increased amount of donation volume represents additional warm glow for the donor, as they have increased their impact of their donation. Second, this warm glow can strengthen future intentions towards donating blood in the future, which then positively impacts the donation volume choice in the donor's future session as donors continue to want to experience the warmest glow. We now describe the results of a more formal analysis, whereby we control for donor history and their characteristics alongside other factors.

To study the impact of the induced donation volume on return propensity, we build for each donation session the variable *Return,* which equals 1 if the donor donates again after their focal donation and 0 otherwise. To study the impact of the chosen donation volume on the propensity to return, we build the variable *Difference*, which captures the difference between the actual donation volume and the predicted amount in the focal session.[5] A positive value of *Difference* indicates that additional donation volumes

[5] The prediction model used in these analyses follows that of Columns (3) and (4) in Appendix Table B7, that is, a multinomial logit model, but the model is trained on the records used in Appendix Table A1. The model includes an additional control variable which indicates whether the donation is done in the voluntary setting and the interaction of the indicator variable with log(*voluntary donation experience*).

were induced. The interaction between *Difference* and the nurse's experience measures the effect of induced donation volume by an experienced nurse. We build a linear probability model relating the *Difference* and its interaction term with *log(voluntary donation experience)* on *Return*, while controlling for donor characteristics, location fixed effects, nurse fixed effects, and time fixed effects as done in Section 4.3.

To study the impact of the donation volume from the prior session on the returning session, we build the variable *PriorDifference*, which captures the difference between the actual donation volume and the predicted one in the prior session. A positive value of *PriorDifference* indicates additional donation volumes were induced. Its interaction with the experience of the nurse in the prior session measures the effect of extra donation volume induced by an experienced nurse. We run a regression relating *PriorDifference* and its interaction term to the donation volume of the focal (returning) session, while controlling for donor characteristics, location fixed effects, nurse fixed effects, and time fixed effects as done in Section 4.3. We also control for the time since last donation (<183 days as reference category, 183-364 days until return, 1-2 years until return, 2+ years until return).

Both analyses described previously use the regression sample as in Section 5, though for the first analysis, we focus on donations which occurred prior to 2017 (as *Return* would equal 0 for most of these donations due to the 6-month minimum time between donations requirement), and for the second analysis, the sample is limited to donors who have donated previously.

Table 5 shows the corresponding regression results. Column (1) shows that there is a positive and significant effect of *Difference* on return donation. A standard deviation increase in *Difference* suggests an increase of 49.24 * (0.000458 – 0.000002) = 2.25% in return probability. With the average value of *Return* in the sample for Column (1) being 0.322, this represents a 6.97 percentage point increase in return probability relative to the mean. We also observe that both *log(voluntary donation experience)* and its interaction with *Difference* do not affect the return probability.

Column (2) shows that conditional on donating again, *PriorDifference* also has a significant impact on the subsequent session's donation volume. A standard deviation increase in *Difference* suggests an increase of 48.12 ml * (0.362+0.011) = 18 ml in donation volume. With the average donation volume in the sample for Column (2) being 373.75 ml, this represents a 4.82% percentage point increase in donation volume relative to the mean. Moreover, we observe that the main effects of experience from the focal and donor's prior session are statistically insignificant, as we are focusing on existing donors by construction. Although the experience of the nurse in the prior session does not affect the donation volume in the current session, its interaction with *PriorDifference* is positive and significant, suggesting that extra blood

---

The predicted value is the expected donation volume, that is, the predicted probability of 200 (or 300 or 400) ml multiplied by the corresponding donation volume.

donation volume induced by an experienced nurse in the prior session encourages the returning donor to choose a high donation volume in the current session.

The results suggest that "overdonation" is beneficial for the donor lifecycle and does not induce malign deception. Rather, donors who have donated more than predicted in a session are likely to return to donate again, and when they do donate, they tend to choose the higher donation volumes. More interestingly, conditional on returning to donate, donors who are encouraged by experienced nurses to donate more previously tend to donate higher volumes in the returning session.

Table 5: The Impact of Induced Donation Volume and Experience

Subsample	Return <2017 donations	Donation Volume
VARIABLES	(1)	(2)
Log(Voluntary Donation Experience)	-0.001088	0.454
	(0.001560)	(0.375)
Log(Voluntary Donation Experience) at Donor's Prior Donation		-0.083
		(0.148)
PriorDifference: Donor's Prior Session Donation Volume - Prior Session Predicted Donation Volume		0.363***
		(0.026)
Log(Voluntary Donation Experience) at Donor's Prior Donation x PriorDifference		0.011***
		(0.003)
183-364 days until return (base category within 183 days)		-3.917***
		(0.760)
365-729 days (1-2 yrs) until return		-9.396***
		(0.698)
730+ days (2+ years) until return		-13.375***
		(0.844)
Difference: Donation Volume - Predicted Donation Volume	0.000458***	
	(0.000134)	
Log(Voluntary Donation Experience) x Difference	-0.000002	
	(0.000017)	
Constant	0.348214***	265.328***
	(0.060647)	(11.096)
Observations	216,376	73,773
R-squared	0.145	0.337
Donor Controls	Yes	Yes
Time Fixed Effects	Yes	Yes
Location Fixed Effects	Yes	Yes
Nurse Fixed Effects	Yes	Yes

Robust standard errors in parentheses, clustered by nurse
*** p<0.01, ** p<0.05, * p<0.1

8. Discussion and Conclusion

Our study identifies a non-trivial value of charitable workers in driving donation outcomes. We show that accumulating relevant *voluntary donation experience* increases donation outcomes while other experiences which focus less on interacting with donors are less beneficial in increasing productivity.

Furthermore, the effect of *voluntary donation experience* varies depending on the donor—namely, it has a stronger effect on donors with lower self-efficacy in their donation. The concordance of nurse experience with a particular group of donors benefits charitable productivity when interacting with such donors. Extending beyond the focal donation session, we find that conditional on returning, higher donation volumes induced by experienced nurses are correlated with higher donation volumes in the return session.

This work provides an operational lens on the value of charitable workers and how they could be allocated more effectively for better outcomes. In contrast, the existing charitable giving literature has focused primarily on donor-side interventions to improve outcomes instead of focusing on the value of workers; there exists scant evidence on the value of charitable workers. Our work generalizes key findings from the empirical operations management literature, such as the impact of experience and the differential value of certain types of experience, to the unique nature of charitable giving. Charitable giving involves 1) warm glowing donors, 2) donors as active decision makers, and 3) a non-trivial distinction in the pairing of worker and donor. Such donors contrast other settings whereby workers may not directly interact with customers as part of their process, or where customers may simply comply or not hold a utility function driven by warm glow.

Our findings are important, and especially critical in the COVID-19 pandemic, with severe blood shortages occurring due to heightened demand for blood and decreased number of blood donors. First, our findings suggest that donors experience increased utility and warm glow when they donate higher amounts of blood. In contrast to for-profit settings where "overselling" may be a concern, or charitable giving settings where "compassion fatigue" may be of concern (if individuals are asked too often to donate; Drucker 2012), our findings suggest that donating higher than the predicted amount of blood for a session appears to be beneficial towards the donor lifecycle and the organization in the long run.

Second, our results suggest that more experienced nurses should be paired with donors with lower self-efficacy to improve charitable productivity. Our counterfactual analyses suggest that leveraging worker and donor side data to improve the matching of charitable workers and donors may provide economically significant gains in the short and long term, enabling charitable organizations to better realize their objectives and a channel for blood banks to help alleviate shortage.

Third, our findings can be operationalized by charitable organizations which have appointment/reservation systems for their donors or when there are multiple staff members working at a particular location to better match workers and donors. That is, prior data about walk-ins at various locations can be used to help inform which workers may be a better match to work with such donors and convince them to donate what may be most in need. Our blood bank has recently implemented a donor scheduling system, which opens the possibility of testing the insights from this study in practice.

Our study has limitations, which also motivate future research directions. First, our data comes from one blood bank. Future research can explore whether our results generalize to other blood banks in other countries who offer multiple donation options as part of their collection strategy. Second, our work does not investigate exactly what nurses say or do in their interactions which lead to higher productivity. Future research can further delve into the interaction process between charitable workers and donors (e.g. via interviews) to identify what factors within the interaction help charitable organizations induce improved outcomes. Third, we are unable to study the impact of some other key operational factors identified in the operations management literature in our empirical setting. For instance, variety has been shown to be important to impact outcomes in contexts like banking and software (Madiedo et al. 2020, Narayanan et al. 2009, Staats and Gino 2012). Although variety in the task is not prevalent in our context within day-to-day experiences of a nurse, such factors may play a role in other charitable settings. Understanding their potential impacts could lead to additional relevant managerial implications.

References

Andreoni J (1989) Giving with Impure Altruism: Applications to Charity and Ricardian Equivalence. *J. Polit. Econ.* 97(6).

Andreoni J (1990) Impure Altruism and Donations to Public Goods: A Theory of Warm-Glow Giving. *Econ. J.* 100(401).

Andreoni J, Payne AA (2011) Is crowding out due entirely to fundraising? Evidence from a panel of charities. *J. Public Econ.* 95(5–6):334–343.

Aprahamian H, Bish DR, Bish EK (2019) Optimal risk-based group testing. *Manage. Sci.* 65(9):4365–4384.

Argote L, Epple D (1990) Learning curves in manufacturing. *Science (80-.).* 247(4945):920–924.

Ayer T, Zhang C, Zeng C, White CC, Roshan Joseph V (2019) Analysis and improvement of blood collection operations. *Manuf. Serv. Oper. Manag.* 21(1):29–46.

Bandura A (1977) Self-efficacy: Toward a unifying theory of behavioral change. *Psychol. Rev.* 84(2).

Bani M, Giussani B (2010) Gender differences in giving blood: A review of the literature. *Blood Transfus.* 8(4).

Bénabou R, Tirole J (2006) Incentives and prosocial behavior. *Am. Econ. Rev.* 96(5):1652–1678.

Berenguer G, Shen ZJ (Max) (2019) Challenges and Strategies in Managing Nonprofit Operations: An Operations Management Perspective. *Manuf. Serv. Oper. Manag.* 22(5):888–905.

Berry Jaeker JA, Tucker AL (2017) Past the point of speeding up: The negative effects of workload saturation on efficiency and patient severity. *Manage. Sci.* 63(4):1042–1062.

Boh WF, Slaughter SA, Espinosa JA (2007) Learning from experience in software development: A multilevel analysis. *Manage. Sci.* 53(8):1315–1331.

Cohen MA (1976) Analysis of Single Critical Number Ordering Policies for Perishable Inventories. *Oper. Res.* 24(4):726–741.

Cohen MA, Pierskalla WP (1979) Target inventory levels for a hospital blood bank or a decentralized regional blood banking system. *Transfusion* 19(4):444–454.

Croson R, Gneezy U (2009) Gender differences in preferences. *J. Econ. Lit.* 47(2).

Dellavigna S, List JA, Malmendier U (2012) Testing for altruism and social pressure in charitable giving. *Q. J. Econ.* 127(1).

Dokko G, Wilk SL, Rothbard NP (2009) Unpacking prior experience: How career history affects Job Performance. *Organ. Sci.* 20(1).

Drucker P (2012) *Managing the Non-Profit Organization*

Ferguson E, Taylor M, Keatley D, Flynn N, Lawrence C (2012) Blood donors' helping behavior is driven by warm glow: More evidence for the blood donor benevolence hypothesis. *Transfusion* 52(10).

Filiz-Ozbay E, Ozbay EY (2014) Effect of an audience in public goods provision. *Exp. Econ.* 17(2).

Fishbein M, Ajzen I (2011) *Predicting and changing behavior: The reasoned action approach*

France JL, France CR, Himawan LK (2008) Re-donation intentions among experienced blood donors: Does gender make a difference? *Transfus. Apher. Sci.* 38(2).

Frey BS, Meier S (2004) Social comparisons and pro-social behavior: Testing conditional cooperation in a field experiment. *Am. Econ. Rev.* 94(5):1717–1722.

Gneezy U, List JA (2006) Putting behavioral economics to work: Testing for gift exchange in labor markets using field experiments. *Econometrica* 74(5):1365–1384.

Gneezy U, Rustichini A (2000) Pay Enough or Don't Pay at All*. *Q. J. Econ.* 115(3):791–810.

Greenwood BN, Carnahan S, Huang L (2018) Patient-physician gender concordance and increased mortality among female heart attack patients. *Natl. Acad Sci.*

Greenwood BN, Hardeman RR, Huang L, Sojourner A (2020) Physician-patient racial concordance and disparities in birthing mortality for newborns. *Proc. Natl. Acad. Sci. U. S. A.* 117(35).

Guo N, Wang J, Ness P, Yao F, Dong X, Bi X, Mei H, et al. (2011) Analysis of Chinese donors' return behavior. *Transfusion* 51(3).

Hu W, Meng H, Hu Q, Feng L, Qu X (2019) Blood donation from 2006 to 2015 in Zhejiang Province, China: Annual consecutive cross-sectional studies. *BMJ Open* 9(5).

Huckman RS, Staats BR (2011) Fluid tasks and fluid teams: The impact of iversity in experience and team familiarity on eam performance. *Manuf. Serv. Oper. Manag.* 13(3).

KC DS, Staats BR (2012) Accumulating a portfolio of experience: The effect of focal and related experience on surgeon performance. *Manuf. Serv. Oper. Manag.* 14(4):618–633.

KC DS, Terwiesch C (2009) Impact of workload on service time and patient safety: An econometric analysis of hospital operations. *Manage. Sci.* 55(9):1486–1498.

KC DS, Terwiesch C (2012) An econometric analysis of patient flows in the cardiac intensive care unit. *Manuf. Serv. Oper. Manag.* 14(1).

Kraft T, Valdés L, Zheng Y (2018) Supply chain visibility and social responsibility: Investigating consumers' behaviors and motives. *Manuf. Serv. Oper. Manag.* 20(4):617–636.

Lacetera N, Macis M (2010) Social image concerns and prosocial behavior: Field evidence from a nonlinear incentive scheme. *J. Econ. Behav. Organ.* 76(2).

Lacetera N, Macis M, Slonim R (2012) Will there be blood? Incentives and displacement effects in pro-social behavior. *Am. Econ. J. Econ. Policy* 4(1):186–223.

Lacetera N, Macis M, Slonim R (2014) Rewarding Volunteers: A Field Experiment. *Manage. Sci.* 60(5):1107–1129.

List JA (2011) The market for charitable giving. *J. Econ. Perspect.* 25(2):157–180.

List JA, Price MK (2009) The role of social connections in charitable fundraising: Evidence from a natural field experiment. *J. Econ. Behav. Organ.* 69(2):160–169.

Madiedo JP, Chandrasekaran A, Salvador F (2020) Capturing the Benefits of Worker Specialization: Effects of Managerial and Organizational Task Experience. *Prod. Oper. Manag.* 29(4):973–994.

Marcus AD (2020) U.S. Blood Reserves Are Critically Low. *Wall Str. J.* Retrieved (September 28, 2020), https://www-wsj-com.proxy.library.upenn.edu/articles/u-s-blood-reserves-are-critically-low-11591954200.

Masser BM, White KM, Hyde MK, Terry DJ (2008) The Psychology of Blood Donation: Current Research and Future Directions. *Transfus. Med. Rev.* 22(3):215–233.

Masser BM, White KM, Hyde MK, Terry DJ, Robinson NG (2009) Predicting blood donation intentions and behavior among Australian blood donors: Testing an extended theory of planned behavior model. *Transfusion* 49(2).

Meer J (2011) Brother, can you spare a dime? Peer pressure in charitable solicitation. *J. Public Econ.* 95(7–8):926–941.

Narayanan S, Balasubramanian S, Swaminathan JM (2009) A Matter of Balance: Specialization, Task Variety, and Individual Learning in a Software Maintenance Environment. *Manage. Sci.* 55(11):1861–1876.

Ou-Yang J, Bei CH, He B, Rong X (2017) Factors influencing blood donation: a cross-sectional survey in Guangzhou, China. *Transfus. Med.* 27(4).

Pisano GP, Bohmer RMJ, Edmondson AC (2001) Organizational differences in rates of learning: Evidence from the adoption of minimally invasive cardiac surgery. *Manage. Sci.* 47(6):752–768.

Podolsky A, Kini T, Darling-Hammond L (2019) Does teaching experience increase teacher effectiveness? A review of US research. *J. Prof. Cap. Community* 4(4).

Reich P, Roberts P, Laabs N, Chinn A, McEvoy P, Hirschler N, Murphy EL (2006) A randomized trial of blood donor recruitment strategies. *Transfusion* 46(7):1090–1096.

Rodriguez Perez J, Ordóñez de Pablos P (2003) Knowledge management and organizational competitiveness: A framework for human capital analysis. *J. Knowl. Manag.* 7(3):82–91. (August 1).

Ryzhov IO, Han B, Bradić J, Smith RH, Bradi J (2016) Cultivating Disaster Donors Using Data Analytics. *Manage. Sci.* 62(3):849–866.

Schlumpf KS, Glynn SA, Schreiber GB, Wright DJ, Randolph Steele W, Tu Y, Hermansen S, Higgins MJ, Garratty G, Murphy EL (2008) Factors influencing donor return. *Transfusion* 48(2).

Shan H, Wang JX, Ren FR, Zhang YZ, Zhao HY, Gao GJ, Ji Y, Ness PM (2002) Blood banking in China. *Lancet* 360(9347):1770–1775.

Shi L, Wang J, Liu Z, Stevens L, Sadler A, Ness P, Shan H (2014) Blood donor management in China. *Transfus. Med. Hemotherapy* 41(4).

Shi L, Wang JX, Stevens L, Ness P, Shan H (2014) Blood safety and availability: Continuing challenges in China's blood banking system. *Transfusion* 54(2).

Singh J, Teng N, Netessine S (2019) Philanthropic campaigns and customer behavior: Field experiments on an online taxi booking platform. *Manage. Sci.* 65(2):913–932.

Slonim R, Wang C, Garbarino E (2014) The market for blood. *J. Econ. Perspect.* 28(2):177–196.

Staats BR, Gino F (2012) Specialization and variety in repetitive tasks: Evidence from a Japanese bank. *Manage. Sci.* 58(6):1141–1159.

Sun T, Gao G, Jin GZ (2019) Mobile messaging for offline group formation in prosocial activities: A large field experiment. *Manage. Sci.* 65(6):2717–2736.

Sun T, Lu SF, Jin GZ (2016) Solving shortage in a priceless market: Insights from blood donation. *J. Health Econ.* 48:149–165.

Takeshita J, Wang S, Loren AW, Mitra N, Shults J, Shin DB, Sawinski DL (2020) Association of Racial/Ethnic and Gender Concordance Between Patients and Physicians With Patient Experience Ratings. *JAMA Netw. open* 3(11).

Tan TF, Netessine S (2014) When does the devil make work? An empirical study of the impact of workload on worker productivity. *Manage. Sci.* 60(6):1574–1593.

Tan TF, Netessine S (2019) When you work with a superman, will you also fly? An empirical study of the impact of coworkers on performance. *Manage. Sci.* 65(8):3495–3517.

Valentine MA, Tan TF, Staats BR, Edmondson AC (2019) Fluid teams and knowledge retrieval: Scaling service operations. *Manuf. Serv. Oper. Manag.* 21(2).

Veldhuizen I, Ferguson E, De Kort W, Donders R, Atsma F (2011) Exploring the dynamics of the theory of planned behavior in the context of blood donation: Does donation experience make a difference? *Transfusion* 51(11).

Wallis CJD, Jerath A, Coburn N, Klaassen Z, Luckenbaugh AN, Magee DE, Hird AE, et al. (2022) Association of Surgeon-Patient Sex Concordance with Postoperative Outcomes. *JAMA Surg.* 157(2).

Wang J, Guo N, Guo X, Li J, Wen GX, Yang T, Yun Z, et al. (2010) Who donates blood at five ethnically and geographically diverse blood centers in China in 2008. *Transfusion* 50(12).

World Health Organisation (2012) *Blood donor selection: guidelines on assessing donor suitability for blood donation*

Yin YH, Li CQ, Liu Z (2015) Blood donation in China: Sustaining efforts and challenges in achieving safety and availability. *Transfusion* 55(10).

Yu C, Holroyd E, Cheng Y, Fai Lau JT (2013) Institutional incentives for altruism: Gifting blood in China. *BMC Public Health* 13(1).

Zaller N, Nelson KE, Ness P, Wen G, Bai X, Shan H (2005) Knowledge, attitude and practice survey regarding blood donation in a Northwestern Chinese city. *Transfus. Med.* 15(4).

Appendix to Worker Experience and Donor Heterogeneity: The Impact of Charitable Workers on Donors' Blood Donation Decisions

Appendix A. Supplemental Descriptive Statistics and Background

Table A1 Comparison between Voluntary and Group Donations

	Voluntary (n = 268,168)	Group (n = 173,168)	t stat
New Donor	0.667 (0.471)	0.739 (0.439)	51.1
Donor's # of Times Donating	1.774 (1.643)	1.440 (0.978)	-76.2
Female	0.407 (0.491)	0.353 (0.478)	-35.8
Weight	65.580 (11.367)	64.251 (10.649)	-38.9
Married	0.434 (0.496)	0.281 (0.449)	-87.25
Age	28.195 (9.155)	23.720 (7.909)	-1700

Note: mean (standard deviation) reported for each dimension (row) and donation setting (column). All t statistics correspond to $p < 0.0000$. Slightly different number of records (i.e. voluntary n = 268,168 instead of 267,941) due to application of inclusion criteria (i.e. locations with blood collection over 30 days) across both donation settings.

Table A2 Donor Groups and Donation Outcomes

Donor Group	N	Mean	SD	Donate 200ml	Donate 300ml	Donate 400ml
New Donor	178593	353.6	59.8	5.4%	35.5%	59.1%
Existing Donor	89348	372.9	51.1	3.2%	20.7%	76.1%
High Weight	138316	379.6	46.6	2.7%	15.0%	82.3%
Low Weight	129599	339.3	61.2	6.8%	47.2%	46.1%
Male	158910	370.4	52.5	3.3%	22.9%	73.7%
Female	109031	345.0	61.7	6.7%	41.6%	51.7%
Total	267941	360.1	57.8	4.7%	30.5%	64.8%

Table A3 Extended Summary Statistics

Variable	N	Mean	SD
Donation Volume	267,941	360.1	57.8
log(Voluntary Donation Experience)	267,941	7.7	1.2
log(Total Experience)	267,941	8.2	1.2
Percentage Voluntary Donations	267,941	0.6	0.1
Log(Voluntary Donation Experience _ New Donor _ last 3 months)	267,941	5.1	0.6
Log(Voluntary Donation Experience _ Female _ last 3 months)	267,941	4.6	0.6
Log(Voluntary Donation Experience _ Low Weight _ last 3 months)	267,941	4.8	0.7
Returned to Donate	267,941	0.3	0.5
Difference: Donation Volume - Predicted Donation Volume	231,610	0.0	49.2
PriorDifference: Donor's Prior Session Donation Volume - Prior Session Predicted Donation Volume	79,372	5.0	48.0
Log(Voluntary Donation Experience) at Donor's Prior Donation	89,334	7.9	1.2
Previous Locations Worked	267,941	17.9	7.8
log(Voluntary Days Worked)	267,941	5.8	1.1
log(Total Days Worked)	267,941	6.0	1.1
Percentage Voluntary Days	267,941	0.9	0.1
Log(Group Donation Experience)	267,941	7.0	1.5
Log(Voluntary Donation Experience _ New Donor _ last year)	267,941	6.3	0.8
Log(Voluntary Donation Experience _ Female _ last year)	267,941	5.8	0.8
Log(Voluntary Donation Experience _ Low Weight _ last year)	267,941	6.0	0.8
Nurse Tenure	267,941	3.3	2.7
New Donor	267,941	0.7	0.5
Female	267,941	0.4	0.5
Age	267,941	28.2	9.2
Weight	267,915	65.6	11.4
Low Weight	267,915	0.5	0.5
Sbp	267,922	115.5	10.6
Pulse	267,777	72.5	3.5
Married	234,442	0.4	0.5
Education - 9 years	264,091	0.2	0.4

Education - 12 years	264,091	0.3	0.5
Education - 16 years	264,091	0.5	0.5
Education -18 years	264,091	0.0	0.2
Education - Other	264,091	0.0	0.0
PastDonation = 0	267,941	0.7	0.5
PastDonation = 1	267,941	0.2	0.4
PastDonation = 2	267,941	0.1	0.3
PastDonation = 3	267,941	0.0	0.2
PastDonation = 4	267,941	0.0	0.1
PastDonation = 5	267,941	0.0	0.1
PastDonation = 6	267,941	0.0	0.1
PastDonation = 7	267,941	0.0	0.1
PastDonation = 8	267,941	0.0	0.1
PastDonation = 9	267,941	0.0	0.1
PastDonation = 10+	267,941	0.0	0.1
Nurse Donor Past Interactions = 0	267,941	1.0	0.2
Nurse Donor Past Interactions = 1	267,941	0.0	0.1
Nurse Donor Past Interactions = 2	267,941	0.0	0.0
Nurse Donor Past Interactions = 3+	267,941	0.0	0.0
Blood Type A	267,814	0.3	0.5
Blood Type AB	267,814	0.1	0.3
Blood Type B	267,814	0.3	0.4
Blood Type O	267,814	0.3	0.5
1 Nurse Active at Location-Day	267,941	0.5	0.5
Workload	267,941	1.6	1.8
No Incentive	267,941	0.3	0.4
Team Incentive	267,941	0.1	0.4
Individual Incentive	267,941	0.6	0.5
TestPass	267,814	1.0	0.2

A.1. Discussion on Nurse Location Assignment

Despite the institutional details which should rule out the endogeneity issues with the rotations, we perform additional analyses on the pairing of nurses to specific locations. As planning is done at the yearly level, we consider how the nurse experience at the beginning of the year is related to first, the assigned locations' performance in the previous year, and second, the modalities in which the nurse works over the year.

For the first analysis, with each location, we calculate their 1) their average voluntary donation volume and 2) average daily number of voluntary donations. We then construct our measures of interest as follows: 1) $HighVol_{imt}$ as a variable that equals 1 if location m worked at during the day *t* for a nurse *i* has an average voluntary donation volume that is higher than the median location's average voluntary donation volume for that year, and $Busy_{imt}$ as a variable that equals 1 if the location m worked at during the day *t* for a nurse *i* has a higher average donations per day than the median location for that year. The dependent variables used in the analysis, Mean($HighVol_{imt}$) and Mean($Busy_{imt}$), represent the averaged values of $HighVol_{imt}$ and $Busy_{imt}$ across the location-days of which the nurses were paired. Our independent variables, log(Voluntary Donation Experience), log(Total Experience), and Percentage Voluntary Donations, represent the accumulated experience by nurse *i* at the end of year *t-1*. We also double cluster our standard errors by nurse and year given that operations within a year may be different. Table A4 shows that we do not find strong evidence that nurse experience plays a role in determining location allocation.

We also verify such analysis holds at the daily level for nurse assignment. For this additional analysis, we build a panel at the nurse-day level that captures the nurse experience gained up to the end of day t-1. Here, the dependent variable $HighVol_{imt}$ and $Busy_{imt}$ for nurse *i* at location m during day *t* involves the yearly level data comparison.[1] We run regressions with independent variables of either log(Voluntary Donation Experience) or log(Total Experience) and Past Percentage Voluntary Donations,

[1] In the rare cases where nurses work more than one location in a day, the last location that the nurse works at during the day is used.

time fixed effects (day of week, month-year) and nurse fixed effects. Table A5 shows largely similar results as Table A4, besides experience being positively correlated with being located at a busy location (when nurse fixed effects are not included).

For the second analysis, we study whether more experienced nurses may be more likely to be assigned to group donation. We construct a variable *percentage group days* to consider a nurse's concentration in working in the group donation environment during the year and relate the nurses' experience at the start of the year to this variable. We control for nurse and year fixed effects and cluster our standard errors by nurse and year. Supporting the institutional details, we observe in Table A6 that there are no significant effects of experience to group donation environment.

Additionally, a concern could be that the total number of locations worked at could play a significant role, which could complicate the tests on Hypothesis 1 and 2. We run the specifications which we use for Hypothesis 1 and 2 and add an additional variable – the number of previous locations worked by the nurse prior to the donation to the model. Table A7 shows the results. We see in the models that control for donor characteristics (Columns 2 and 4) that the previous locations worked variable has a positive and insignificant effect. The median number of locations worked is 18 per nurse, so the effect is small. More importantly, our main findings remain to be robust.

A.2. Information About Donor Satisfaction Surveys

The donor satisfaction survey is conducted by the blood bank on a half year basis, with surveys collected on a random subsample of donors (60-200) in an anonymous form for aggregated results. The survey contains several sections, including:

Background information about the donor

- Whether donating blood is harmful to the body (original language before translation: 您认为献血对身体是否有害)
- How many times has one donated previously (1, 2, 3, 4+)
- What is the best time to donate blood (9-11, 11-14, 14-17, 17-20)
- How to increase your enthusiasm for blood donation (increased publicity, blood donation points, elimination of unit subsidies, other: 加大宣传, 增加献血点, 取消单位补贴, 其它)
- Where the blood center can increase public relation efforts (TV, newspaper, broadcast, bus, WeChat, Weibo)

Quality of Service

- Blood donor staff reception/consultation experience (工作人员献血宣传及对献血者接待咨询)
- Blood center's work on safety and health for blood donors (目前血液中心在献血者安全及健康方面的工作)
- Medical laboratory examiner's service attitude and technical level (体检化验医生服务态度技术水平)
- Blood collection staff's service attitude and technical level (采血人员服务态度技术水平)
- Blood Donation Card Issuer's Service Attitude (发放献血证人员服务态度)
- Environment of blood donation/rest (献血及休息环境)

The Quality of Service rating is the key focus in the survey. The donors would answer such questions with their satisfaction rate (0-100%), and an average score is computed based off the responses to the questions. The blood bank sets very high goals for the satisfaction ranking. Hence, nurses are motivated to follow through with good service quality, else they risk not achieving the service goals. We note here that the quality of service questions may seem like different staff members are handling a donor's donations. However, in our blood bank one nurse handles all of these roles.

The data supports the standards set by the blood bank, with almost no variation (99%+ satisfaction) in the quality of service ratings. This provides additional support for no improper blood collection occurring.

Table A4 Location Assignment Analysis

Dependent Variables	Mean(HighVolume)		Mean(Busy)		Mean(HighVolume)		Mean(Busy)	
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log(Voluntary Donation Experience)	0.020		0.020*		-0.005		0.011	
	(0.013)		(0.010)		(0.011)		(0.008)	
log(Total Experience)		0.015		0.015		-0.024**		-0.002
		(0.015)		(0.011)		(0.009)		(0.007)
Percentage Voluntary Donations		0.073		0.051		0.288**		0.165
		(0.145)		(0.125)		(0.100)		(0.129)
2007	-0.127**	-0.116**	0.190***	0.199***	-0.063	-0.063	0.172**	0.175***
	(0.042)	(0.043)	(0.017)	(0.021)	(0.104)	(0.086)	(0.058)	(0.053)
2008	-0.133**	-0.129*	-0.308***	-0.304***	-0.012	0.002	-0.299***	-0.288***
	(0.060)	(0.068)	(0.033)	(0.036)	(0.037)	(0.049)	(0.068)	(0.070)
2009	0.184***	0.199***	-0.135***	-0.127**	0.114**	0.180***	-0.225**	-0.189**
	(0.023)	(0.031)	(0.041)	(0.042)	(0.045)	(0.050)	(0.080)	(0.076)
2010	0.072	0.090*	-0.056	-0.044	0.052	0.092	-0.099	-0.072
	(0.046)	(0.047)	(0.038)	(0.037)	(0.065)	(0.059)	(0.069)	(0.069)
2011	-0.026	-0.006	-0.004	0.010	-0.006	0.052	-0.046	-0.009
	(0.046)	(0.045)	(0.056)	(0.053)	(0.052)	(0.042)	(0.098)	(0.093)
2012	0.068*	0.090**	0.024	0.040	0.065	0.136***	-0.040	0.007
	(0.032)	(0.036)	(0.053)	(0.054)	(0.046)	(0.041)	(0.098)	(0.097)
2013	-0.016	0.006	0.175***	0.190***	0.012	0.088	0.121*	0.170**
	(0.048)	(0.056)	(0.019)	(0.025)	(0.054)	(0.060)	(0.065)	(0.065)
2014	-0.115***	-0.092**	-0.055*	-0.038	-0.136***	-0.075	-0.147***	-0.103*
	(0.035)	(0.038)	(0.025)	(0.022)	(0.042)	(0.044)	(0.045)	(0.047)
2015	-0.270***	-0.252***	-0.113***	-0.099***	-0.200***	-0.131**	-0.150*	-0.099
	(0.043)	(0.043)	(0.021)	(0.021)	(0.059)	(0.048)	(0.078)	(0.081)
2016	-0.212***	-0.190***	-0.051	-0.033	-0.127**	-0.038	-0.089	-0.027
	(0.052)	(0.052)	(0.041)	(0.036)	(0.057)	(0.052)	(0.060)	(0.063)
2017	-0.257***	-0.234***	-0.402***	-0.383***	-0.166**	-0.065	-0.450***	-0.381***
	(0.054)	(0.052)	(0.033)	(0.035)	(0.062)	(0.062)	(0.085)	(0.084)
Constant	0.642***	0.609***	0.562***	0.539***	0.020	-0.248**	0.279***	0.126
	(0.060)	(0.076)	(0.054)	(0.075)	(0.037)	(0.101)	(0.067)	(0.147)
Observations	372	372	372	372	372	372	372	372
R-squared	0.151	0.145	0.256	0.249	0.515	0.535	0.548	0.552
Nurse Fixed Effects	No	No	No	No	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses, clustered by nurse and year
*** p<0.01, ** p<0.05, * p<0.1

Table A5 Location Assignment Analysis (Daily Level)

Dependent Variables	HighVolume		Busy		HighVolume		Busy	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
log(Voluntary Donation Experience)	0.028		0.041**		0.007		0.032	
	(0.020)		(0.018)		(0.024)		(0.020)	
log(Total Experience)		0.030		0.044**		0.007		0.033
		(0.020)		(0.018)		(0.020)		(0.018)
Past Percentage Voluntary Donations		0.386		0.566**		0.576**		0.598**
		(0.227)		(0.255)		(0.252)		(0.199)
Constant	0.722***	0.404	0.402***	-0.064	0.176***	-0.474	0.323**	-0.347
	(0.130)	(0.265)	(0.118)	(0.288)	(0.015)	(0.283)	(0.108)	(0.275)
Observations	41,214	41,214	41,214	41,214	41,214	41,214	41,214	41,214
R-squared	0.090	0.097	0.112	0.125	0.211	0.219	0.183	0.190
Nurse Fixed Effects	No	No	No	No	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses, clustered by nurse and year
*** p<0.01, ** p<0.05, * p<0.1

Table A6 Relationship of Experience with Group Donation Allocation

	Dependent Variable: Percentage Group Days	
VARIABLES	(1)	(2)
Log(Voluntary Donation Experience)	-0.008	
	(0.006)	
Log(Total Experience)		-0.002
		(0.005)
Percentage Voluntary Donations		-0.082
		(0.054)
Constant	0.919***	0.909***
	(0.063)	(0.062)
Observations	419	419
R-squared	0.700	0.702
Nurse Fixed Effects	Yes	Yes
Year Fixed Effects	Yes	Yes
Mean of Dependent Variable	0.196	0.196

Robust standard errors in parentheses, clustered by nurse and year
*** p<0.01, ** p<0.05, * p<0.1

Table A7 Locations Worked

VARIABLES	Dependent Variable: Donation Volume			
	(1)	(2)	(3)	(4)
Log(Voluntary Donation Experience)	1.104*	1.361**		
	(0.573)	(0.641)		
Log(Total Experience)			0.763	1.037
			(0.540)	(0.617)
Percentage Voluntary Donations			14.472***	13.461***
			(2.878)	(3.120)
Previous Locations Worked	0.076	0.013	0.222*	0.147
	(0.134)	(0.160)	(0.129)	(0.157)
Constant	345.457***	227.846***	332.069***	215.235***
	(6.548)	(12.832)	(7.017)	(13.286)
Observations	267,941	231,610	267,941	231,610
R-squared	0.047	0.225	0.048	0.226
Donor Controls	No	Yes	No	Yes
Location Fixed Effects	Yes	Yes	Yes	Yes
Nurse Fixed Effects	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes

Robust standard errors in parentheses, clustered by nurse and location
*** p<0.01, ** p<0.05, * p<0.1

Appendix B. Regression Tables for Robustness Checks

Table B1 Impact of Experience on Donation Volume Decisions (Experience Measured on Donations only in Final Sample)

	Dependent Variable: Donation Volume			
VARIABLES	(1)	(2)	(3)	(4)
Log(Voluntary Donation Experience)	1.352***	1.411***		
	(0.295)	(0.371)		
Log(Total Experience)			1.323***	1.394***
			(0.289)	(0.361)
Past Percentage Voluntary Donations			21.604***	20.474***
			(4.599)	(4.508)
Constant	345.987***	227.902***	328.082***	211.286***
	(6.603)	(12.185)	(7.281)	(12.811)
Observations	267,941	231,610	267,941	231,610
R-squared	0.047	0.225	0.048	0.226
Donor Controls	No	Yes	No	Yes
Location Fixed Effects	Yes	Yes	Yes	Yes
Nurse Fixed Effects	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes

Robust standard errors in parentheses, clustered by nurse and location
*** p<0.01, ** p<0.05, * p<0.1

Table B2 Alternative Measures for Voluntary Donation Experience (Days Worked)

	Dependent Variable: Donation Volume			
VARIABLES	(1)	(2)	(3)	(4)
log(Voluntary Days Worked)	1.393***	1.435***		
	(0.341)	(0.405)		
log(Total Days Worked)			1.121***	1.158***
			(0.323)	(0.399)
Percentage Voluntary Donation Days			12.355**	11.956**
			(5.001)	(5.528)
Constant	348.070***	230.137***	338.946***	221.489***
	(5.868)	(11.808)	(6.879)	(12.535)
Observations	267,941	231,610	267,941	231,610
R-squared	0.047	0.225	0.047	0.225
Donor Controls	No	Yes	No	Yes
Location Fixed Effects	Yes	Yes	Yes	Yes
Nurse Fixed Effects	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes

Notes: Voluntary Days Worked is the number of days worked by the nurse prior to the donation in which at least 1 donation was performed in the voluntary setting, while Total Days Worked tracks the total number of days worked by the nurse (as defined as having collected a blood donation during a day) prior to the blood donation. Percentage Voluntary Donation Days is the ratio between Voluntary Days Worked and Total Days Worked. Robust standard errors in parentheses, clustered by nurse and location. Significance reported as *** p<0.01, ** p<0.05, * p<0.1.

Table B3 Alternative Time Window for Concordant Experience (1 year)

	Dependent Variable: Donation Volume		
VARIABLES	(1)	(2)	(3)
Log(Voluntary Donation Experience _ New Donor _ last year)	0.531		
	(0.479)		
New Donor	-23.096***		
	(3.782)		
New Donor x Log(Voluntary Donation Experience _ New Donor _ last year)	1.146**		
	(0.560)		
Log(Voluntary Donation Experience _ Female _ last year)		0.654*	
		(0.350)	
Female		-5.706**	
		(2.439)	
Female x Log(Voluntary Donation Experience _ Female _ last year)		1.550***	
		(0.391)	
Log(Voluntary Donation Experience _ Low Weight _ last year)			0.617
			(0.442)
Low Weight			-40.963***
			(2.309)
Low Weight x Log(Voluntary Donation Experience _ Low Weight _ last year)			1.507***
			(0.448)
Nurse Tenure	-2.349	-2.924	-4.666
	(6.669)	(6.532)	(6.708)
Constant	247.026***	273.449***	403.833***
	(80.915)	(79.055)	(80.836)
Observations	231,610	231,610	231,610
R-squared	0.223	0.225	0.194
Donor Controls	Yes -No Past # or History	Yes	Yes - No Continuous Weight
Nurse Fixed Effects	Yes	Yes	Yes
Location Fixed Effects	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes

Robust standard errors in parentheses, clustered by nurse and location
*** p<0.01, ** p<0.05, * p<0.1

Table B4 Effect of Different Experiences using the Sample of Group Donations

	Dependent Variable: Donation Volume					
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Log(Voluntary Donation Experience)	1.104*	1.361**				
	(0.573)	(0.641)				
Log(Total Experience)			0.763	1.037		
			(0.540)	(0.617)		
Past Percentage Voluntary Donations			14.472***	13.461***		
			(2.878)	(3.120)		
Log(Group Donation Experience)					-0.175	0.042
					(0.355)	(0.378)
Previous Locations Worked	0.076	0.013	0.222*	0.147	0.272**	0.212
	(0.134)	(0.160)	(0.129)	(0.157)	(0.114)	(0.138)
Constant	345.457***	227.846***	332.069***	215.235***	350.629***	233.438***
	(6.548)	(12.832)	(7.017)	(13.286)	(6.346)	(13.000)
Observations	267,941	231,610	267,941	231,610	267,941	231,610
R-squared	0.047	0.225	0.048	0.226	0.047	0.225
Donor Controls	No	Yes	No	Yes	No	Yes
Nurse Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Location Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses, clustered by nurse and location
*** p<0.01, ** p<0.05, * p<0.1

Table B5 Mechanism Analysis: Peer Effects

	Dependent Variable: Donation Volume		
	Full Sample	Working Alone	Working with Peers
VARIABLES	(1)	(2)	(3)
Log(Voluntary Donation Experience)	1.492***	1.333**	1.377***
	(0.320)	(0.592)	(0.460)
1 Active Nurse for Location-Day	2.327		
	(3.336)		
Log(Voluntary Donation Experience) x 1 Active Nurse for Location-Day	-0.211		
	(0.421)		
Constant	227.134***	234.496***	225.620***
	(12.087)	(18.949)	(16.475)
Observations	231,610	109,133	122,477
R-squared	0.225	0.222	0.232
Donor Controls	Yes	Yes	Yes
Nurse Fixed Effects	Yes	Yes	Yes

Location Fixed Effects	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes

Robust standard errors in parentheses, clustered by nurse and location
*** p<0.01, ** p<0.05, * p<0.1

Table B6 Certain Nurses Driving Result

	Dependent Variable: Donation Volume							
	October 2005 Nurse		January 2006 Nurse		2017 Worker		No Report Experiment	
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log(Voluntary Donation Experience)	1.014***		0.889**		1.205**		1.380***	
	(0.353)		(0.333)		(0.445)		(0.368)	
Log(Total Experience)		1.048***		0.900***		1.383***		1.480***
		(0.341)		(0.327)		(0.429)		(0.354)
Past Percentage Voluntary Donations		9.717**		9.274**		13.599***		12.870***
		(3.833)		(3.732)		(3.708)		(3.098)
Constant	240.905***	233.244***	237.938***	230.606***	236.245***	224.456***	229.192***	218.094***
	(11.274)	(11.715)	(11.904)	(12.266)	(13.070)	(13.810)	(12.243)	(12.870)
Observations	168,547	168,547	156,645	156,645	193,307	193,307	225,159	225,159
R-squared	0.224	0.225	0.224	0.224	0.226	0.226	0.226	0.226
Donor Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Nurse Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Location Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses, clustered by nurse and location
*** p<0.01, ** p<0.05, * p<0.1

Table B7 Multinomial Logit Model Specifications for Hypotheses 1-2

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES / 200 is base category	300	400	300	400	300	400	300	400
Log(Voluntary Donation Experience)	1.025	1.069***	1.024	1.084**				
	(0.0211)	(0.0253)	(0.0245)	(0.0341)				
Log(Total Experience)					1.026	1.074***	1.026	1.091***
					(0.0206)	(0.0249)	(0.0237)	(0.0342)
Percentage Voluntary Donations					1.400	2.082***	1.388	2.303***
					(0.409)	(0.574)	(0.428)	(0.696)
Constant	1.951*	2.534**	3.018**	0.00131***	1.382	1.191	2.153	0.000553***
	(0.668)	(1.099)	(1.642)	(0.00103)	(0.543)	(0.541)	(1.231)	(0.000453)
Observations	267,941	267,941	231,610	231,610	267,941	267,941	231,610	231,610
Donor Controls	No	No	Yes	Yes	No	No	Yes	Yes
Nurse Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Location Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Relative risk ratios reported. Robust standard errors in parentheses, clustered by nurse.
*** p<0.01, ** p<0.05, * p<0.1

Table B8 The Effect of Incentives

	Dependent Variable: Donation Volume			
	Full Sample		Subsample Prior to March 2013	
VARIABLES	(1)	(2)	(3)	(4)
Log(Voluntary Donation Experience)	1.394***		1.337*	
	(0.378)		(0.743)	
Log(Total Experience)		1.500***		1.216
		(0.357)		(0.753)
Past Percentage Voluntary Donations		12.931***		13.804***
		(3.106)		(3.992)
Team Incentive	5.315	5.391	5.875	5.873
	(5.066)	(5.066)	(5.331)	(5.349)
Individual Incentive	14.738**	14.745**		
	(5.839)	(5.897)		
Constant	213.280***	202.170***	238.849***	229.242***
	(12.990)	(13.361)	(11.387)	(12.584)
Observations	231,610	231,610	106,905	106,905
R-squared	0.225	0.226	0.243	0.243
Donor Controls	Yes	Yes	Yes	Yes
Nurse Fixed Effects	Yes	Yes	Yes	Yes
Location Fixed Effects	Yes	Yes	Yes	Yes
Time Fixed Effects	Yes	Yes	Yes	Yes

Robust standard errors in parentheses, clustered by nurse and location
*** p<0.01, ** p<0.05, * p<0.1

Table B9 Analysis on Pass Rate

	Dependent Variable: TestPass	
VARIABLES	(1)	(2)
Donation Volume	0.00002	0.00002
	(0.00001)	(0.00001)
Log(Voluntary Donation Experience)	-0.00130	
	(0.00083)	
Log(Total Experience)		-0.00118
		(0.00084)
Percentage Voluntary Donations		0.00606
		(0.00604)
Team Incentive	-0.01323	-0.01317
	(0.01523)	(0.01523)
Individual Incentive	-0.01298	-0.01295
	(0.01552)	(0.01557)
Constant	1.15858***	1.15305***
	(0.03855)	(0.04015)
Observations	231,610	231,610
R-squared	0.02930	0.02931
Donor Controls	Yes	Yes
Nurse Fixed Effects	Yes	Yes
Location Fixed Effects	Yes	Yes
Time Fixed Effects	Yes	Yes

Robust standard errors in parentheses, clustered by nurse and location
*** p<0.01, ** p<0.05, * p<0.1

Table B10 Analysis with Workload

	Dependent Variable: Donation Volume	
VARIABLES	(1)	(2)
Log(Voluntary Donation Experience)	1.453***	
	(0.358)	
Log(Total Experience)		1.550***
		(0.346)
Percentage Voluntary Donations		12.865***
		(3.107)
Workload	-0.671***	-0.667***
	(0.218)	(0.220)
Constant	228.925***	217.821***
	(12.360)	(13.101)
Observations	231,610	231,610
R-squared	0.226	0.226
Donor Controls	Yes	Yes
Nurse Fixed Effects	Yes	Yes
Location Fixed Effects	Yes	Yes
Time Fixed Effects	Yes	Yes

Robust standard errors in parentheses, clustered by nurse and location
*** p<0.01, ** p<0.05, * p<0.1

Appendix C: Managerial Implications: Counterfactual Analyses

C.1 Simulation Methods

Having understood how nurse experience can be salient for donation outcomes and how its effects can be moderated by donors' level of control, we perform a series of counterfactual estimates to understand the potential benefits of using these insights to better match nurses and donors for improved

outcomes. To illustrate the potential benefits, we utilize donation records in the 2011 1st half to perform counterfactual estimates.

We perform two types of counterfactual estimates. The first tries to understand the effect of pairing nurses and donors individually without considering resource constraints to see an upper bound to the value of improved matching. Such system may be implemented if organizations have an appointment system that could dynamically incorporate information to improve staffing decisions. The second falls considers matching of existing nurses to locations each day, which parallels the blood bank's practice of scheduling nurses

We make the following assumption regarding our donors as part of the simulation. First, we assume that the donor would have donated regardless of the nurse being staffed at the location at the day, i.e., the nurse impacts the donor not on the extensive margin (recruiting them to come to the blood center/mobile) but on the intensive margin (their choice of donation volume and their experience at the blood bank). We also simplify the notion of a different nurse by considering nurses have 5 different degrees of voluntary donation experience (hereby discussed as "nurse-counterfactual"), as noted in quintiles of the data.

Following this, we build a multinomial logit model to predict the probability that a nurse i and donor j will donate donation volume $d \in D = \{200ml,\ 300ml,\ 400ml\}$, using covariates $\boldsymbol{C_{ij}}$, which includes the factor variable representation of voluntary donation experience, which is interacted with the donor characteristics identified in Hypothesis 3a-3c – new donors, female, and low weight, several donor characteristics (age, education, marriage status, past donation history, and blood type), and time effects (day of week and month).

$$p_{ijd} = \frac{e^{\boldsymbol{\beta}^T \boldsymbol{C_{ij}}}}{\sum_{d \in D} e^{\boldsymbol{\beta}^T \boldsymbol{C_{ij}}}},\ \forall d \in D$$

We run two simulation types. The first aims to answer: if we could pair nurses and donors individually without considering resource constraints, what would be the effect? This provides a potential upper bound to the value of personalized matching; it considers what organizations could do if they have an appointment system and utilize the information to improve their staffing decisions. The second falls back closer the blood bank's practice of scheduling nurses at locations: within our existing nurses, how should we staff nurses at locations for a day? For the latter, we use the predicted outcomes generated from our multinomial logit model and plug it into a constrained optimization framework.

C.2 Simulation with Personalized Nurse-Donor Pairings

To determine the optimal nurse-counterfactual for each nurse-donor donation interaction, we first estimate the model on the 2011 1st half data using an alternate experience variable: voluntary donation experience by quintiles (0-20th percentile, 20-40th percentile, 40th-60th percentile, 60th-80th percentile, or 80th-100th percentile). Then, we expand the dataset to create our counterfactual comparisons: we vary the degree of nurse experience (0-20th percentile, 20-40th percentile, 40th-60th percentile, 60th-80th percentile, or 80th-100th percentile) that each donor could receive. To evaluate the effect of these alternative matchings, we apply the estimated model to calculate the predicted donation volume for each counterfactual index (0-20th percentile, 20-40th percentile, 40th-60th percentile, 60th-80th percentile, or 80th-100th percentile), whereby the prediction is calculated as $p_{cj200} * 200 + p_{cj300} * 300 + p_{cj400} * 400$ for a certain counterfactual c. We identify the nurse-counterfactual which provides the highest donation volume and denote it as the best nurse. If the nurse-counterfactual chosen is identical to the original nurse's experience category, we note that a change in nurse is not necessarily helpful.

Before showing the results, it is helpful to overview what happened in the 2011 1st half data. As a reference point, out of the 15,704 voluntary donors in the 2011 1st half, 807 donated 200 ml, while 4,032 donated 300 ml, and 10,865 donated 400 ml. This led to a total donation volume of 5,717,000 ml. Had everyone donated 400 ml, the total donation volume would be 6,281,600 ml; in other words, the upper bound in terms of potential gain is 564,600 ml.

Under this simulation framework, we observe that there is a respectable lift to the total donation volume gained of 293,490 ml. This is equivalent to approximately 1,467 additional units of blood (a unit

being 200ml), in other words, 52% of the potential gain (defined as the additional blood collected had everyone donated 400ml) was achieved. This can also be viewed as a 5.1% increase on the existing blood collected. Switching the nurse counterfactual was associated with an average gain of donation volume of 74 ml, with a standard deviation of 39 ml, for 25.4% of donors (30.8% of donors at most could have been impacted). Extrapolating the result to a year, the blood bank could get approximately 62% of a month's worth of additional donation.

C.3 Constrained Optimization

Section C.2 discusses the simulation when we can allocate nurses to donors individually, without consideration of resource constraints—i.e., we might allocate nurses in the highest experience category more so than what our data show regarding nurses' availability. Hence, one would also suggest considering resource constraints into the simulation framework.

We formulate a constrained optimization problem to consider these resource constraints, and pair nurses to locations at the location-day level, as mostly done in current practice. Our decision variable is what nurse counterfactual type should be assigned to a location for the day, i.e., a_{ijt} equals 1 if we assign nurse counterfactual type i to location j at day t. Utilizing the estimates in Section C.1, we aggregate the results to the nurse-counterfactual-location-day level to determine how much blood would be collected had the nurse-counterfactual performed all the donations at the location day. We then formulate the following optimization problem:

$$max \sum_{t \in T} \sum_{i \in I_t} \sum_{j \in J_t} u_{ijt} \times a_{ijt}$$

$$subject\ to \sum_{j \in J_t} a_{ijt} \leq ncf_{it} \quad \forall i \in I_t, t \in T$$

$$\sum_{i \in I_t} a_{ijt} \leq 1 \quad \forall j \in J_t, t \in T$$

$$a_{ijt} \in \{0,1\}\ \forall i \in I_t, j \in J_t, t \in T$$

In this problem, we maximize the total predicted blood collected; in other words, we want to maximize the triple sum of $a_{ijt} \times u_{ijt}$, representing the predicted blood collected by nurse counterfactual type i to location j at day t if the nurse counterfactual type is indeed assigned to the location at that day. We have a constraint that the number of a particular nurse counterfactual assigned during the day must be less than or equal to what appears in our dataset (ncf_{it}) and to make a more general assumption that given that the median staffing is 1 at most locations, we subject the number of assigned nurse-counterfactuals to a location to be at maximum 1.

Solving this optimization problem, we see that the generated donation volume is equal to 5,762,440 ml, or a 5,762,440 - 5,717,000 = 45,440 ml increase in donated blood. This is an additional gain of $45{,}440/5{,}717{,}000 = 0.80\%$ increase in overall blood donated, or 8.05% of the potential gain achieved, or equivalent to an additional 227 units of blood. Extrapolating this result to a year, this would bring in approximately 9.54% of an average month's voluntary donation volume.

Suppose nurses instead completely focused on voluntary donations. Under the same optimization problem, but with updated for what ncf_{it} by mapping the total number of donations to the total voluntary donation experience category, we resolve the optimization problem and see that the generated donation volume is equal to 5,769,610 ml, or a 5,769,610 – 5,717,000 = 52,610 ml increase in donated blood. This is an additional gain of $52{,}610/5{,}717{,}000 = 0.92\%$ increase in overall blood donated, or 9.32% of the potential gain achieved, or equivalent to an additional 263 units of blood. Extrapolating this result to a year, this would bring in approximately 11% of an average month's voluntary donation volume.