ABSTRACT

Background: Little information is available regarding expected phlebotomy cycle time (total time needed to draw a blood specimen) in inpatient settings. Examining this variable in 4 hospitals in Calgary, Alberta, Canada, we determined the distribution of phlebotomy cycle times and compared this by hospital and by phlebotomist experience.

Methods: Between April 2014 and August 2014, we observed phlebotomy timing at 4 adult acute care hospital locations. Phlebotomists were stratified into 3 experience levels: 0 to 2 years, 2 to 5 years, and more than 5 years. We observed a total of 110 different phlebotomists.

Results: We observed no statistical difference between experience levels (P = .07) or hospital location (P = .44) on mean phlebotomy cycle time.

Conclusions: The mean (SD) phlebotomy cycle time was 259 (52) seconds per patient for normal phlebotomy procedures. If expected minimum and maximum phlebotomy times are defined as mean ± 2 SD, the expected cycle time range is 196 to 404 seconds.

Keywords: phlebotomy, process excellence, laboratory management, laboratory training

There is considerable interest in improving quality assurance in the preanalytic phase of laboratory testing.1-4 As an important preanalytic component, previous research on phlebotomy procedures (hereafter, phlebotomies) has demonstrated that in the inpatient setting, these procedures are subject to frequent administrative inefficiencies;5 nevertheless, the vast majority of outpatient phlebotomies are successful.6 The phlebotomy process itself, however, has received less quality-assurance attention. A review of phlebotomy quality improvement by Lippi et al1 highlighted the need for improved standardization of phlebotomy technique, in addition to other training and administrative issues.

A key preanalytic element, namely, the expected mean phlebotomy cycle time, has received little attention. A single previous paper7 cites a mean (SD) phlebotomy cycle time of 10.4 (2.4) minutes for a hospital in Hong Kong, but this number is difficult to apply to other settings because it included travel time back to the laboratory after phlebotomies.7 Defined minimum, mean, and maximum phlebotomy-cycle times would be beneficial to help laboratory professionals understand and manage phlebotomy workload and balance staff scheduling. Further, the minimum and maximum phlebotomy cycle time can be used as a staff performance indicator. Phlebotomists who are consistently completing collections below the minimum cycle time may indicate that process steps are being missed or excluded. Phlebotomies that are constantly completed later than the maximum cycle time may indicate that certain staff members are struggling with the component skills and require additional training.

The purpose of this study is to determine the minimum, mean, and maximum phlebotomy cycle times at 4 acute care hospitals in Calgary, Alberta, Canada. It might be expected that staff members with less experience would take longer to perform phlebotomies; therefore, we also tested for an
association between cycle time, experience level, and hospital.

Materials and Methods

Study Population

This work was performed as part of routine quality-assurance procedures at our laboratory and therefore did not require formal research-ethics approval. From April 2014 through August 2014, data was collected on phlebotomies performed on inpatients only at all 4 adult acute care hospitals in Calgary, Alberta, Canada: the Rockyview General Hospital (RGH), Foothills Medical Centre (FMC), Peter Lougheed Centre (PLC), and the South Health Campus (SHC). We observed each phlebotomist performing approximately 4 to 6 inpatient collections.

We observed only normal phlebotomies. A normal phlebotomy was defined as venipuncture collections on patients aged 16 years and older, excluding patients in isolation, blood culture collections, patients without an identification bracelet, collections requiring shutoff of an intravenous (IV) line, collections requiring phlebotomist completion of unexpected paperwork, and previously unsuccessful phlebotomies. Unsuccessful phlebotomies are defined as specimens that are only partially collected or in which no specimen was obtained due to the difficulty of completing the procedure. Normal phlebotomies represent 75% of our total workload. The data collection and observations consisted of 15% of the daily work volume, 13% of the weekly volume, and 5% of the total monthly volume at each site. We did not measure travel time to and from the units/patients.

Data Collection

A single observer (K.J.) collected all manual timings and visual inspection data, ensuring that all steps of the phlebotomy procedure were performed and fully compliant with the existing standard operating procedures of our institution. The exact steps required in a phlebotomy to make it fully compliant are listed in Table 1.

We defined the start time as the first hand hygiene act by the phlebotomist or the beginning of patient identification (whichever came first) and ending after the final hand hygiene act had concluded. Convenience samples of phlebotomists were selected at each site to represent a range of experience levels. The observer selected phlebotomists at each of the 4 sites based on their experience level, availability of viable adult blood collections, and whether the staff member had been previously observed in this study. No staff members refused to participate. Non-normal phlebotomies, such as those performed on patients in isolation, blood cultures, those involving veins that were difficult to find and/or puncture, and those involving IV shutoffs were not included in the data collection due to the numerous variables present with each circumstance. It was critical to include different

Table 1. Steps Required for a Fully Compliant Phlebotomy Procedure, Per the Standards of Calgary Laboratory Services, Alberta, Canada

<p>| | |</p>
<table>
<thead>
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<tbody>
<tr>
<td>1.</td>
<td>Perform first act of hand hygiene</td>
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<tr>
<td>2.</td>
<td>Greet patient and introduce yourself</td>
</tr>
<tr>
<td>3.</td>
<td>Check the first and last name and identification number of the patient on the hospital bracelet, have the patient state his/her first and last name and date of birth</td>
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<tr>
<td>4.</td>
<td>Assess the patient for factors that would make phlebotomy procedure risky (eg, presence of an IV site)</td>
</tr>
<tr>
<td>5.</td>
<td>Obtain verbal or implied consent from the patient</td>
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<tr>
<td>6.</td>
<td>Put on gloves and personal protective equipment</td>
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<tr>
<td>7.</td>
<td>Assess phlebotomy site</td>
</tr>
<tr>
<td>8.</td>
<td>Select/prepare the required phlebotomy equipment</td>
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<tr>
<td>9.</td>
<td>Cleanse the phlebotomy site</td>
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<td>10.</td>
<td>Apply tourniquet</td>
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<tr>
<td>11.</td>
<td>Collect phlebotomy specimen following order of draw</td>
</tr>
<tr>
<td>12.</td>
<td>Perform postphlebotomy care (apply pressure, check site before placing tape on site) and thank patient</td>
</tr>
<tr>
<td>13.</td>
<td>Clean up phlebotomy supplies and waste</td>
</tr>
<tr>
<td>14.</td>
<td>Perform second act of hand hygiene</td>
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IV indicates intravenous.
experience levels in the data group to substantiate whether there was a correlation between experience level and cycle time; data was not collected from new staff members who had not completed their full training. (It takes approximately 3 weeks for new employees to be fully trained in the phlebotomy procedures specific to their unit; within 2 months, these employees are expected to complete a single [normal] phlebotomy in the same time period as their more experienced colleagues.) For analysis purposes, we divided phlebotomy staff into 3 experience levels (0 to 2 years, 2 to 5 years, and 5+ years), which were chosen to represent the breadth of experience levels within our institution and to provide an adequate numbers of phlebotomists to observe.

We timed 611 phlebotomies performed by 110 different phlebotomists. We recorded data from approximately 150 timings per site, representing 50 timings from each of the 3 staff-experience levels. Most of the timings were collected on phlebotomies of inpatients that required 2 to 3 tubes drawn. All cycle times were recorded as seconds per patient.

**Data Analyses**

We imported the data into SPSS software, version 19 (IBM SPSS Inc), to perform statistical analyses. Cycle times were compared among phlebotomist experience level and among hospitals by first averaging all cycle times for a given phlebotomist (which reduced the 611 separate timings into 110 data points) and then subjecting this data to a 2-way analysis of variance (ANOVA) test. An alpha value of less than 0.05 was considered to be statistically significant.

**Results**

The cycle times we observed at each of the 4 hospitals are shown as box plots in Figure 1. To assess the underlying distribution of phlebotomy cycle times, we performed a Kolmogorov-Smirnov test of normality on the aggregate data, the results of which were nonsignificant ($P = .20$), indicating that there was no statistical deviation from a normal distribution. There was only minor variation in mean cycle time among the 3 experience levels. Those with less than 2 years of experience had a mean (SD) cycle time of 259 (50) seconds; for those with 2 to 5 years of experience, 242 (46) seconds; and for those with more than 5 years of experience, 271 (56) seconds. The overall mean (SD) cycle time for all 3 experience levels was 259 (52) seconds. The hospital location mean times were as follows: FMC, 275 seconds; PLC, 259 seconds; RGH, 247 seconds; and SHC, 257 seconds, respectively. The 2-way ANOVA analysis showed no independent significant contribution of experience ($P = .07$) or hospital location ($P = .44$) to mean (SD) cycle time.

**Discussion**

In this study, we attempted to determine the standard phlebotomy cycle time at 4 adult acute care hospitals. This data will be used by our laboratory to define workload expectations and performance indicators, as well as to balance the staff schedules based on the workload demand and the expected time to complete the phlebotomy process as specified by our contractual obligations.

The reasonable assumption that staff members with less experience would show longer cycle times was not supported by our data. The similarity of cycle times among hospitals and phlebotomists with different experience levels suggests that a standard phlebotomist cycle time can be
defined. Based on our data, we define this cycle time as 259 seconds per patient exclusive of travel time or, essentially, 5 patients every 30 minutes or 10 patients every hour. Our data also allowed us to define an expected phlebotomy cycle time range of 196 seconds to 404 seconds (mean +/- 2 SD).

This study has several weaknesses. First, we chose phlebotomists from a convenience sample and not at random. It is possible that some bias existed in the recruitment of phlebotomists. Second, the number of timings for phlebotomists was based on the availability of phlebotomies in a given time period and was not standardized. Despite these weaknesses, the remarkable consistency in mean cycle times seen in different hospitals and with different experience levels suggests that the sampling procedure was adequate.

In conclusion, the data that we collected and analyzed for this study has helped us achieve an acceptable performance indicator for phlebotomists. Specifically, at our institution, we recommend that phlebotomies be performed at a rate of 5 patients per 30 minutes or 10 patients per hour. This indicator makes it possible for managers to monitor the procedure while guaranteeing that all necessary process steps are being followed. The ability to recognize the warning signs of process steps being omitted has been greatly improved by having knowledge of the acceptable cycle time to complete the process. If a staff member continually completes the process in less than the acceptable cycle time, this information would trigger an investigation into why that employee takes less time than the standard to accomplish the procedure and whether any mandatory process steps are being excluded during phlebotomies. Also, the use of the minimum, mean, and maximum cycle times from this study assists in the function of our current workload scheduling model, ensuring that adequate staff members have been allocated to complete all available work within the parameters of our contractual obligations. This cycle time standard has been put in place as a benchmark at our institution and is currently used in our scheduling models. Doing so has improved efficiency at our centers and has proven to be a useful benchmark for phlebotomy performance.

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References