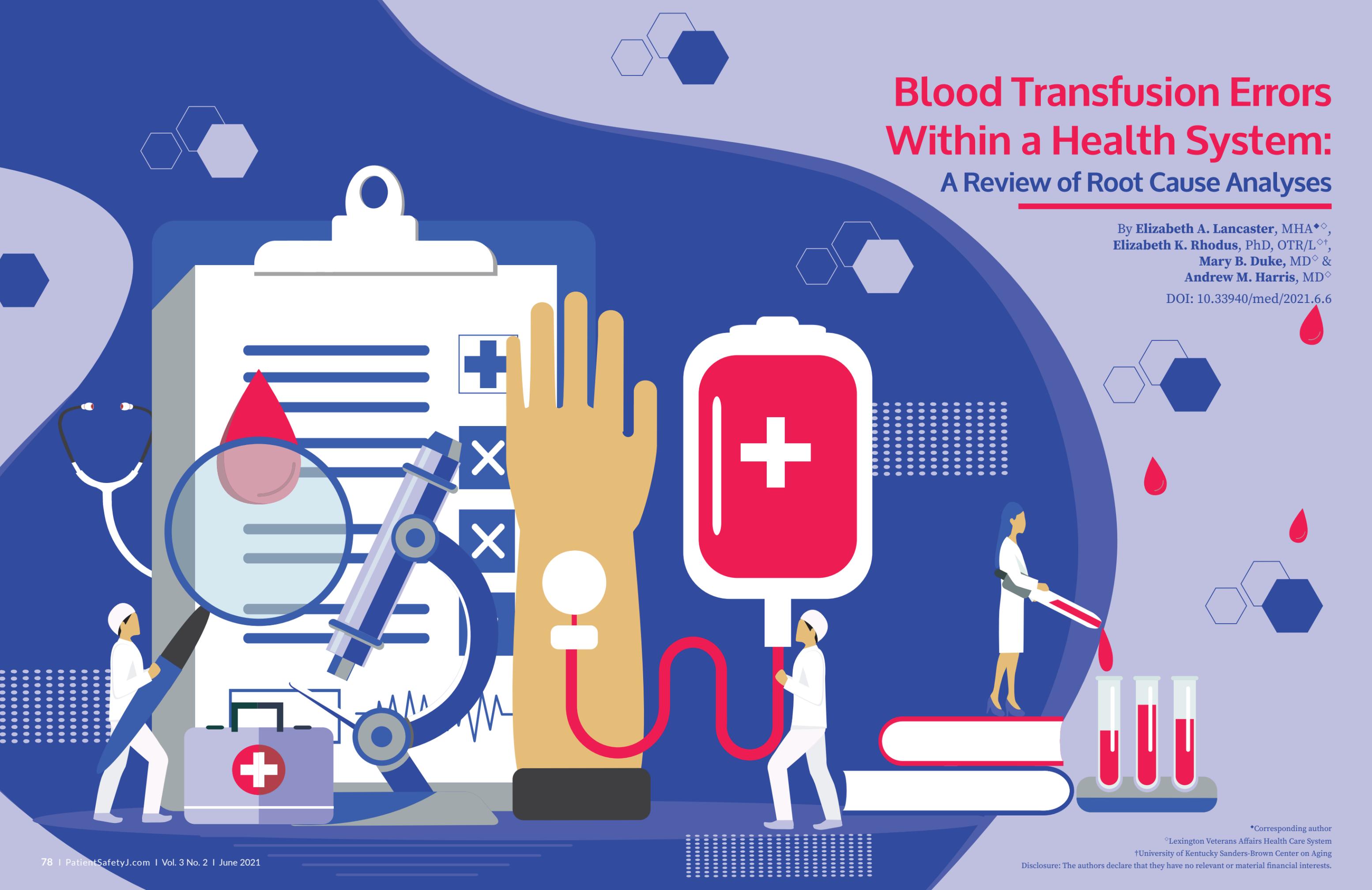# Blood Transfusion Errors Within a Health System:
A Review of Root Cause Analyses

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Abstract

Introduction

Blood transfusions are lifesaving treatments which require critical attention to processes and details. If processes are not followed, grievous errors can lead to sentinel events. A review of investigations completed due to reported events will show the error trends associated with systems used throughout the blood transfusion process.

Methods

This study employed root cause analyses (RCAs) within the Veterans Health Administration (VHA) to review the events leading to blood transfusion errors. Data was pulled from the RCA databases within the VA National Center for Patient Safety. The time frame was October 2014 to August 2019. A total of 53 RCAs and aggregated reviews were included in the study. These were reviewed for common themes and gaps present within processes.

Results

The most common events fell within the categories of incorrect or delayed blood orders, incorrect or lack of patient identification, and wrong blood given. The RCA for each event was reviewed and studied. The RCAs had a crossover of multiple causes; lack of a formal process, communication barriers, and technology barriers were the most frequent.

Conclusion

These RCAs express great variation between VHA facilities, such as process created, number of staff reports, and number of RCAs completed. Lack of standard practices nationwide, training barriers, and technology barriers may explain the variation of transfusion errors throughout the VHA. This study brings to light questions about standardization of transfusion protocols. Future study regarding such standardization is necessary to determine its plausibility.

Introduction

The first idea of practical blood transfusions came about within the 1600s; however, blood transfusions did not become routine procedures until World War II.[1] During this time, the military transfused whole blood to those in need.[2] Now, blood transfusions are used to treat numerous conditions which medications cannot cure: blood loss due to major surgery, trauma, childbirth, severe burns, gastrointestinal (GI) bleeds, bone marrow disorders causing anemia, inherited anemias, and autoimmune hemolytic anemia.[3,4] Specific types of cancers, such as those in the bone marrow and GI tract, as well as chemotherapy and radiation cancer treatments, can cause low blood cell counts.[5] Blood transfusions are used to treat these symptoms.[5] Though blood transfusions create positive outcomes for patients with diagnoses listed above, the procedure has great risks associated with sterilization, correct blood type, reactions, and post-transfusion ailments.

It wasn't until the 20th century that the medical community knew of sterilization, anticoagulation, ABO blood types, and Rh factors.[6,7] If someone receives an incompatible blood type, their outcome could be fatal. When an O-negative person receives AB-positive red blood cells, the A and B antibodies in their plasma will attack the A and B antigens on the transfused cells, causing hemolysis.[2,8] Aside from breakdown of red blood cells, other risks are associated with blood transfusions: fever, allergic reactions, bloodborne infections, and iron overload.[9,10] Injuries to the pulmonary and circulatory systems, in the forms of transfusion-related acute lung injury (TRALI) and transfusion-associated circulatory overload (TACO), can cause further complications.[11,12] When reactions, complications, and fatalities occur during or post-donation they must be reported to the U.S. Food and Drug Administration (FDA).[13,14] Although the number of blood transfusions decrease each year, the number of blood transfusion–related fatalities remains consistent.[15] From 2014 to 2018, there have been 244 *reported* fatalities nationwide: 56 in FY14, 41 in FY15, 60 in FY16, 44 in FY17, and 43 in FY18.[15]

Based on the number of blood transfusions completed at the local facility, the Veterans Health Administration (VHA) does an estimated 220,400 blood transfusions each year. If processes are not in place, the risks can have dire, if not fatal, consequences. Each critical step must be measured and approached with accuracy when a patient undoubtedly needs blood. Blood transfusion process studies have been conducted at non-VHA and non-U.S. hospitals. Errors are possible, and do occur, at any step from the moment the patient verbally consents to a blood transfusion to the end of the procedure.[16] The Institute of Medicine, in *To Err is Human,* states in order to sustain continuous system improvements for patient safety, errors leading to adverse events must be identified and learned from.[17] Previous studies of various errors note root causes result from poor communication, lack of modern and standard operating equipment, insufficient training, lack of standard procedures, high workloads, shortage of nursing staff, and misunderstandings.[18,19] As the largest healthcare system in the United States, the VHA offers an amount of data unavailable in other systems.[20] The purpose of this study is to delve into the VA's blood transfusion processes to study the systems in use within VA facilities. We hypothesize error trends will be identified which are associated with adverse events, sentinel events, and close calls related to the VA's blood transfusion processes.

Methods

Data was requested from the VHA National Center for Patient Safety (NCPS) database. NCPS tracks all patient safety data (inpatient and outpatient) within the VA; and the patient safety manager (PSM) tracks all safety data within their facility. Anyone with VA computer access may input a safety report when a patient is harmed, or could have been harmed, during their care. The PSM reviews each safety event (sentinel, adverse, or close call) and assigns a safety assessment code (SAC) score for actual and potential harm.[21,22] This score is determined using the SAC matrix mapping the severity and frequency of safety events.[22] A SAC score is a scale of increasing risk, 1 being the lowest risk and 3 the highest risk.[21,22] If the safety event has a SAC score of 3, a root cause analysis (RCA) is required.[21,22,23] An RCA can be initiated with a SAC score of 2 at the discretion of the PSM. This analysis is conducted to identify system issues which lead to errors affecting patient care.[23] RCAs are a nonpunitive practice comprised of an interdisciplinary team focused on systems errors.[22,23] Individual actions or human errors are not root causes. Once the series of steps leading to the event are mapped, the root causes are determined.[21] From these root causes, actions are formed to prevent the event from reoccurring; these actions are supported from literature reviews demonstrating their efficacy.[21,23]

This review consisted of RCAs and aggregated reviews. An aggregated review occurs when multiple patient safety event reports can be grouped together and analyzed to determine an effective system improvement.[23] The time frame of data retrieval was October 2014 to August 2019. All inpatient and outpatient blood transfusion RCAs were included. Keywords used to retrieve the data were "phlebotomy/-ist," "accession," "type and cross/screen/match," "blood draw/collection/ work/order/culture/bank/gas/ type," and "blood 'NEAR' tube/label/specimen/sample/occult." This search yielded 83 RCAs and aggregated reviews combined from 140 facilities.

The scope of the project included near misses, sentinel events, and adverse events caused due to errors directly related to steps within the blood transfusion process. Near misses are events which do not cause harm but have the potential to cause harm.[23] Sentinel events are events resulting in a fatality due to error.[23] Adverse events are events which cause nonfatal harm to the patient.[23] Thirty of the eighty-three events were excluded from this analysis. These exclusions were those related to routine inpatient and outpatient lab draws, labeling of routine blood testing tubes, transport of routine testing tubes, and venous drug overdose. RCAs were analyzed for common themes and categorized into event types based on these themes. Each event was then analyzed for root causes.

The blood transfusion process was reviewed through examination of VHA publications and documents. These were used to determine the requirements for each facility, create a process map, and find any indication of potential variation among facilities.

Results

The final dataset includes 53 RCAs, of which 3 were aggregated reviews. Upon reading the reported events and final descriptions, each was sorted into RCA event types, then root causes were determined. **Table 1** has the SAC score totals for each RCA. Several of the SAC actuals were at a level 1 or 2 for risk; however, numerous had the potential to cause severe or fatal harm to the patient.

RCA Event Types

The final dataset includes 53 RCAs, of which 3 were aggregated reviews. The first step was to separate the RCAs into RCA event types, or categories representing the commonalities between RCAs, then root causes were identified. The inclusion criteria details of each event type include:

1. **Patient Identification:** incorrect ID labels, wristband, chart, etc.; lack of proper verification before transfusion

2. **Blood Orders:** delayed orders, orders not followed, orders not received

3. **Wrong Blood:** received the wrong blood type regarding platelet, plasma, and red blood cell transfusions

4. **Blood Label:** labels placed on wrong bags, tags, paperwork

5. **Consent:** lack of informed consent, consent not noted in patient chart, as required before blood is transfused

6. **Crossmatch:** no crossmatch completed before blood given to patient

7. **Transfusion Reactions:** not documented and/or communicated appropriately

Table 1. Total Safety Assessment Code (SAC) Scores

SAC Actual is the level or harm the patient experienced. SAC Potential is the level of harm the patient could have experienced. Please note, the highest SAC score rating is 3.[21,22,23]

Total Number of RCAs Reviewed Within Each Risk Level		
	SAC Actual	SAC Potential
1	37	0
2	10	14
3	4	37
Totals	**51**	**51**

Note: There were 50 RCAs and 3 aggregated reviews. Only 1 aggregated review was scored.

The RCAs are a result of near misses (n=27), adverse events (n=21), and sentinel events (n=5). Three of the sentinel events fell under the criteria for blood orders; the other two were associated with blood labels and the wrong blood. The 4 categories with the highest number of RCAs, as seen in **Figure 1**, were patient identification, blood orders, wrong blood, and blood labels. The remaining 3 event types had 3 or less RCAs: consent, crossmatch, and transfusion reactions.

Root Causes

The second step was to dissect the 50 RCAs and 3 aggregated reviews further. Patterns emerged within each RCA event. This illuminated the numerous root causes and factors leading to errors associated with each patient safety event. A total of 12 root causes were found:

1. Communication barrier
2. Lack of a formal process
3. Environmental barrier
4. No standard operating procedure (SOP)
5. Technology barrier
6. Complex process
7. Training/knowledge barrier
8. Equipment barrier
9. No defined roles
10. No barrier to prevent error(s)
11. Low-frequency task
12. Multitasking

Figure 1. Number of Root Causes Linked to Each RCA Event Type

Multiple root causes were found within each RCA event type: patient identification, wrong blood, blood orders, blood labels, consent, transfusion reactions, and crossmatch. The crossover of these root causes is shown here for each RCA event type.

Figure 2. Route Causes of Blood Transfusion Errors

The Pareto chart indicates which root causes are the most common throughout the RCA events. Over 60% of root causes are due to lack of a process, technology barrier, communication barrier, and training barrier.
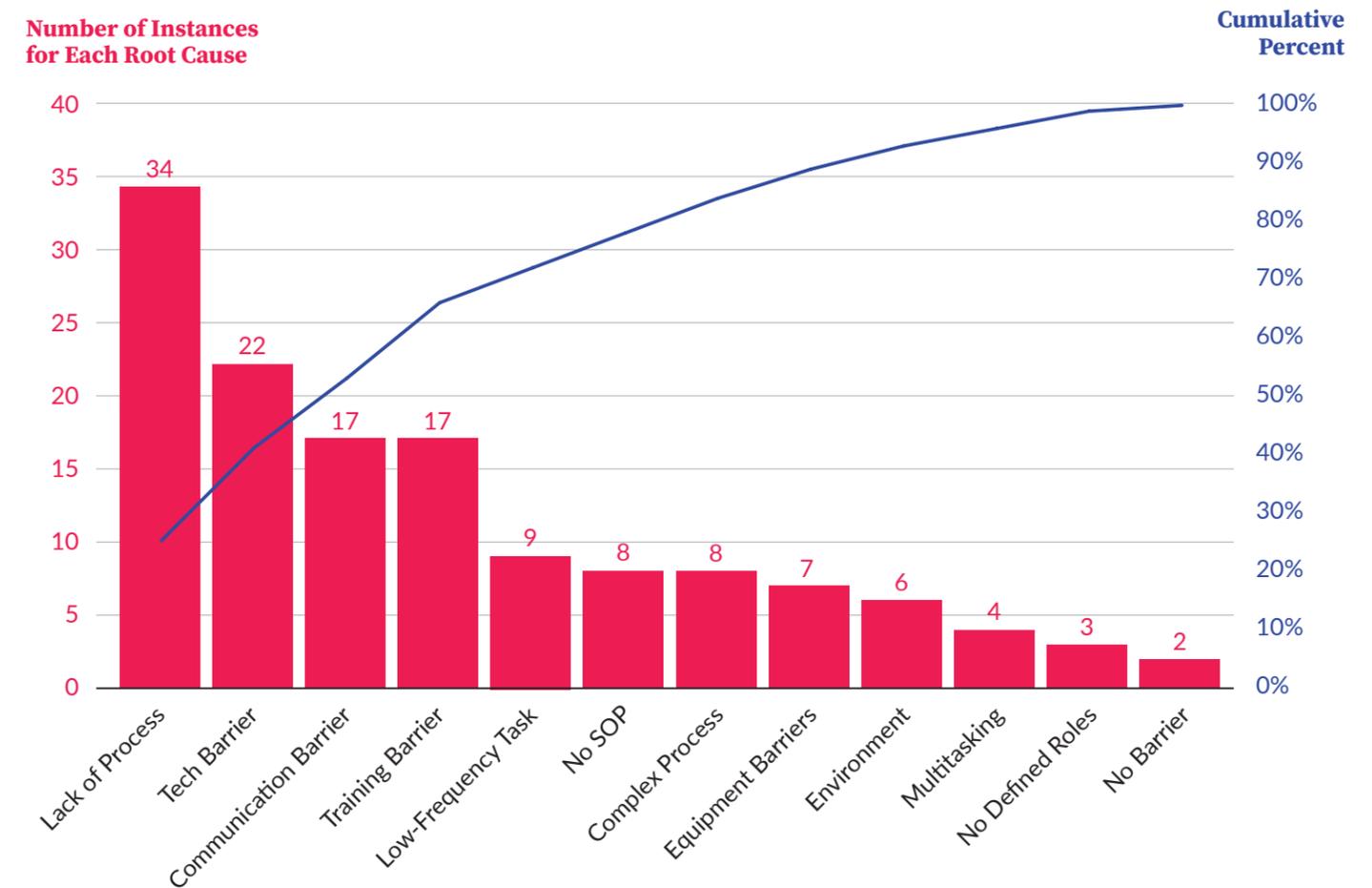

Figure 1 shows how many root causes were linked to each RCA event type. Each event type had at least 5 root causes. The only exception is the event type crossmatch, which had 1 root cause, lack of a formal process. A Pareto chart organized the data by greatest occurrence of each root cause, **Figure 2**. Those with the highest number of occurrences include lack of a formal process (n=34, 24.8%), technology barrier (n=22, 16%), communication barrier (n=17, 12.4%), and training/knowledge barrier (n=17, 12.4%). The remaining root causes occurred 9 or less times.

It is uncommon for a patient safety event to have a single root cause and solution. **Table 2** below gives a succinct description of the reported patient safety event and SAC scores, determined root causes, and actions to be taken. Actions are completed by assigned staff from the unit where the safety event occurred. Outcomes of these actions are monitored and tracked by each facilities' PSM, but they are not uploaded to the RCA database. The most common

actions are updating policies, standardizing processes, improving electronic health record (EHR) functions, education, and creation of signs as cognitive aids.

A process map was developed using the VHA publications and RCA data to show the gaps and process variations between facilities, **Figure 3**. Several steps can be completed in any order. Availability of training and resources varies between the 140 facilities: for example, during the time period not all facilities had transfusion verification software, facilities had different blood bands, access to technology was difficult at some locations, paper and electronic records varied, and training on blood bank software was intermittent between facilities.

Table 2: Analysis Synopses From Blood Transfusion RCA Dataset

There is an example of each RCA event type. These descriptions represent the main findings and actions from the RCA. They do not dictate the entire completed RCA process for each reported safety event.

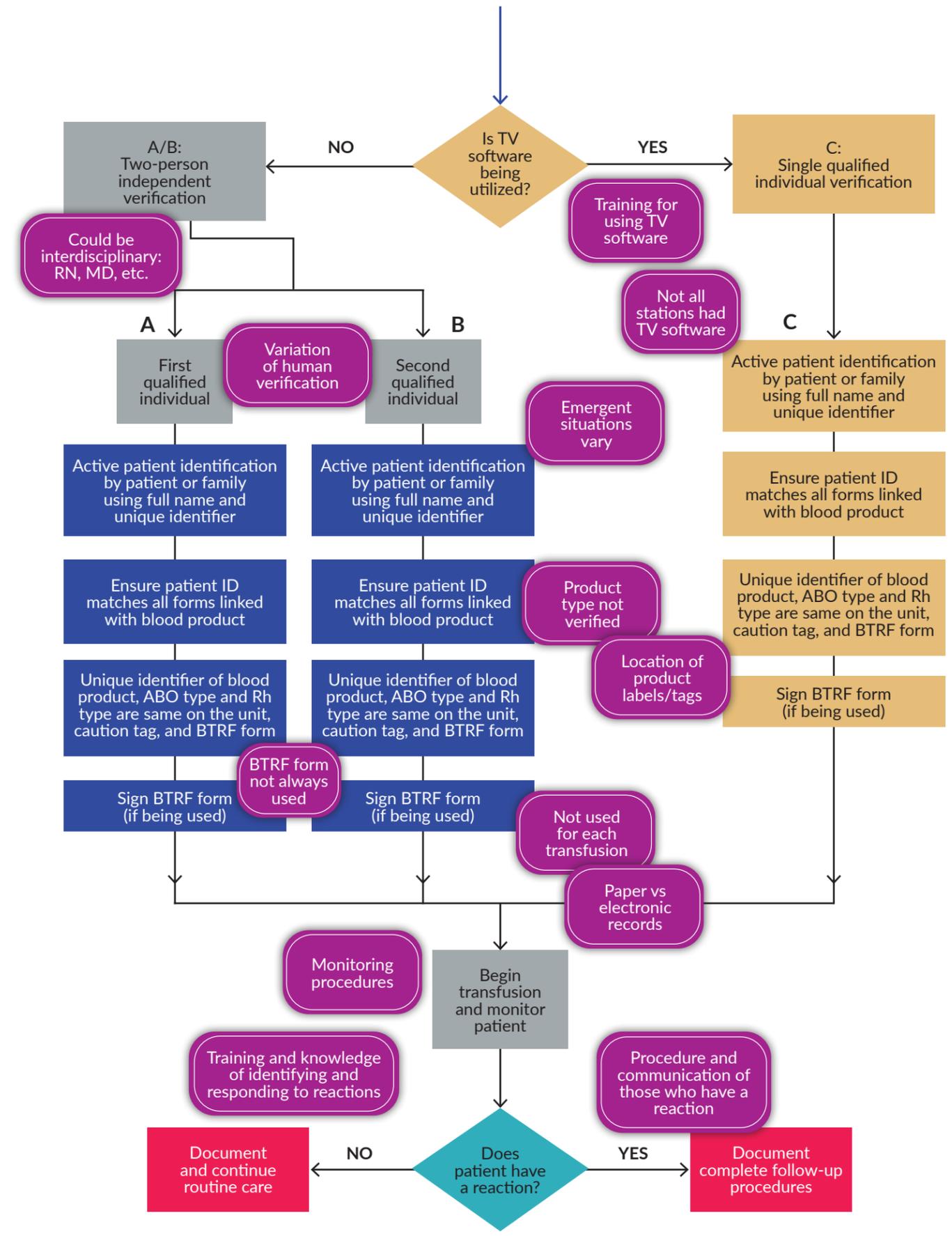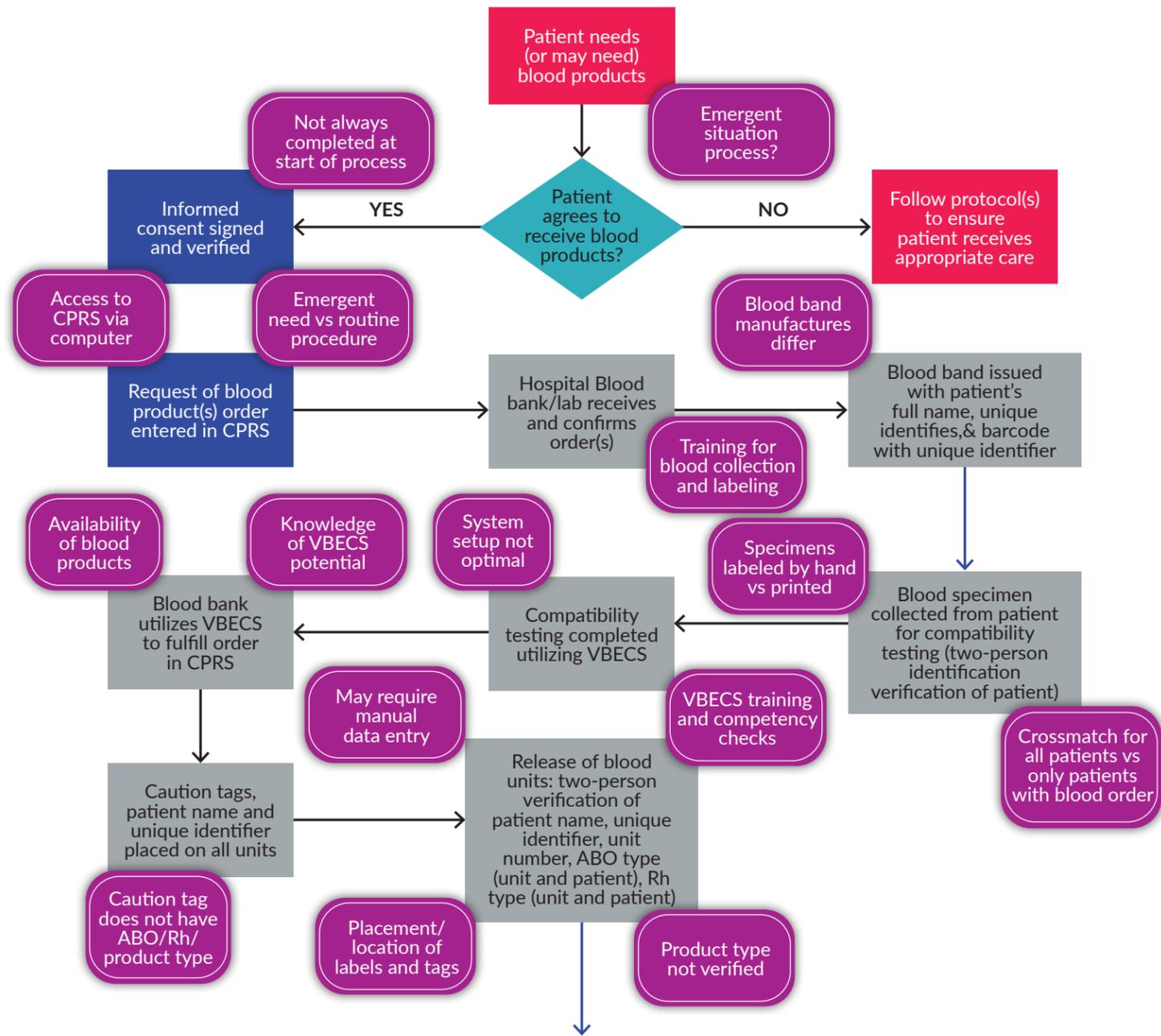| Event Type	Event & Root Cause(s) Description	Actions
Patient Identification	**Safety Event:** Type/screen of RBCs labeled with another patient's information. • Unable to print labels from the patient's medical record at the point of care • Two-person verification of a blood bank specimen not required • Frequent interruptions during the specimen collection • No standardized process for the safe management of printed laboratory requisitions for multiple patients • No standardized process in the clinical laboratory for the receipt and distribution of blood bank specimens SAC Actual: 1 SAC Potential: 3	• Eliminate the use of preprinted labels for specimen collection • Implement point-of-care label printing from the EHR • Implement a bedside second verifier process during the collection of blood bank specimens • Implement a process for individuals performing phlebotomy to limit distractions • Create a warning sign that indicates procedure is in progress and interruptions should be limited. • Implement a standardized process for the sorting/management of printed laboratory requisitions (SOP) • Create a standardized process from the receipt and distribution of blood bank specimens in the lab
Patient Identification	**Safety Event:** Patient's unique R number placed backwards on patient's wrist band. R number not visible during identification and verification. Not noticed until after the patient received two units of blood. • Insufficient training • Limited access to policies related to blood transfusion processes • The style of band with manufacturer's information on the band could obscure R number if the white slip is placed in backwards. SAC Actual: 1 SAC Potential: 3	• Implementation of a training program that includes face-to-face training, simulation training, and competency assessments • Create and post a visual reminder checklist (Patient R number can't be read, etc.) • Hard copy of policies/procedures and templates for blood product infusion will be kept current and available for staff • Replace current band system with system to eliminate extra blood band and create a physical barrier preventing use of an obscured R number
Blood Orders	**Safety Event:** Patient had a massive gastrointestinal (GI) bleed, coded, and passed away. Patient had been on medicine service for GI bleed, then transferred to spinal cord injury (SCI) service, where patient bled again. • Massive blood transfusion (MBT) is a low-frequency, high-risk event with unclear accessibility to decision making support • No process for ordering blood or resource organization for off-tour hours • No standard communication process for staff and leadership support SAC Actual: 3 SAC Potential: 3	• Standardize a massive transfusion protocol using best practice guidelines • Standardize protocols for clinical, laboratory, blood bank and logistic responses, activation triggers, and documentation for the effective management of massive blood loss
Wrong Blood	**Safety Event:** Patient received seven units of fresh frozen plasma (FFP) that were incompatible with their blood type. Occurred during an emergent MBT. Patient had GI bleed, became unresponsive, coded, and passed. • No barrier to prevent removal of the incorrect type of FFP • No process for issuing type-specific versus universal blood products for MBT • Blood bank computer system was bypassed; no verification • Emergency release for blood form does not include the patient's blood type • MBT low-frequency task SAC Actual: 3 SAC Potential: 3	• Additional signs added to inside the red blood cell (RBC) refrigerators and FFP freezers stating the universal donor for that blood product • Amend MBT policy to simplify process • All FFP will be issued using the blood bank computer system. • Emergency release for blood form will be modified to include patient's blood type and a blood product compatibility chart • Time-out upon delivery of the blood products verifying patient, blood type, and compatibility • Education on new policies and processes • Quarterly MBT simulation events and debrief
Blood Label	**Safety Event:** Type/screen in emergency department (ED) indicated an O-positive blood type. Four units of RBCs crossmatched and made available for surgery. Type/screen post surgery indicated Patient had A-negative blood. New samples confirmed A-negative blood. Samples from ED incorrectly labeled. • Policy on collecting and labeling type/screen not followed • Sample not labeled with the patient info at time of collection • Two nurses did not verify sample at bedside • Type/screen and ABO/Rh compatibility performed together • Type/screen label format varies based on the printer location SAC Actual 1 SAC Potential: 3	• Reeducation on policies for type/screen collection • Develop cognitive aid on pertinent steps to take when collecting type/screen • Standardize the type/screen label format throughout the medical center to ensure the correct label format is printed
Consent	**Safety Event:** Electronic health record (EHR) blood transfusion informed consent progress note created. Signed paper consent not scanned into document imaging software. Blood issued by blood bank by viewing note in EHR. Scanned paper consent not viewed. • Vague procedures and policies • Inconsistent verification process between nursing personnel and blood bank personnel SAC Actual: 2 SAC Potential: 2	• Revise process on when paper informed consent is sent to medical records for scanning • Revise annual competency and TMS training with reeducation of what constitutes an actual consent • "Blood Transfusion Directions" sheet to include a checklist of the verification step by step process • Revise the current EHR note to clarify that a paper informed consent was used
Crossmatch	**Safety Event:** Unit of blood documented into blood bank computer system as being crossmatched, issued, and transfused. Testing records indicate the crossmatch was never performed. • Crossmatch labels on red blood cell units, after crossmatch has expired, are retained • Lack of a clear process of assigning red blood cell units to a patient following crossmatch testing SAC Actual: 1 SAC Potential: 2	• Standardize process of expired crossmatch units by removing red blood cell unit crossmatch tags during daily inventory • Standardize the process of assigning red blood cells that have been crossmatched at the time of testing
Transfusion Reactions	**Safety Event:** Patient had symptomatic anemia. Notes referenced possible transfusion reaction, but no workup ever completed. Confusion of who would complete and when the workup would be done. Protocol for transfusion reaction not followed. • No standardized physician order template for blood transfusion(s) • The lack of a medical center memorandum noting blood component can be infused up to four hours SAC Actual: 1 SAC Potential: 2	• Develop a standardized physician's order template for transfusing blood • Update blood transfusion memorandum to include information related to infusion time

Figure 3. Basic Blood Transfusion Process Map

The basic blood transfusion process map was created using VHA publications and information from the RCA data.[24-28] This map brings together the processes for the lab and transfusion to illustrate the complexity of the process from patient needing blood to active transfusion. The red clouds are gaps or variations determined from the RCAs' root causes and final safety event understanding.

- Process Start/Stops
- Critical steps of process completed per each facility's SOPs
- Critical steps which may be completed in varying order
- Part of process not available at all facilities
- Decision point
- Gaps/variation in process between facilities

CPRS = Computerized Patient Record System
VBECS = VistA Blood Establishment Computer Software
TV Software = Transfusion Verification Software
BTRF = Blood Transfusion Record Form

Patient needs (or may need) blood products

- Not always completed at start of process
- Emergent situation process?

Patient agrees to receive blood products?

YES → Informed consent signed and verified
NO → Follow protocol(s) to ensure patient receives appropriate care

- Access to CPRS via computer
- Emergent need vs routine procedure

Request of blood product(s) order entered in CPRS

Hospital Blood bank/lab receives and confirms order(s)

- Blood band manufactures differ
- Training for blood collection and labeling

Blood band issued with patient's full name, unique identifies, & barcode with unique identifier

- Availability of blood products
- Knowledge of VBECS potential
- System setup not optimal
- Specimens labeled by hand vs printed

Blood bank utilizes VBECS to fulfill order in CPRS

Compatibility testing completed utilizing VBECS

- May require manual data entry
- VBECS training and competency checks

Blood specimen collected from patient for compatibility testing (two-person identification verification of patient)

- Crossmatch for all patients vs only patients with blood order

Caution tags, patient name and unique identifier placed on all units

- Caution tag does not have ABO/Rh/ product type

Release of blood units: two-person verification of patient name, unique identifier, unit number, ABO type (unit and patient), Rh type (unit and patient)

- Placement/ location of labels and tags
- Product type not verified

Is TV software being utilized?

NO → A/B: Two-person independent verification
YES → C: Single qualified individual verification

- Could be interdisciplinary: RN, MD, etc.
- Training for using TV software
- Not all stations had TV software

A → First qualified individual
- Variation of human verification
B → Second qualified individual
- Emergent situations vary

A Active patient identification by patient or family using full name and unique identifier

B Active patient identification by patient or family using full name and unique identifier

Ensure patient ID matches all forms linked with blood product

Ensure patient ID matches all forms linked with blood product
- Product type not verified

Unique identifier of blood product, ABO type and Rh type are same on the unit, caution tag, and BTRF form

Unique identifier of blood product, ABO type and Rh type are same on the unit, caution tag, and BTRF form
- Location of product labels/tags

Sign BTRF form (if being used)
- BTRF form not always used
Sign BTRF form (if being used)

C Active patient identification by patient or family using full name and unique identifier

Ensure patient ID matches all forms linked with blood product

Unique identifier of blood product, ABO type and Rh type are same on the unit, caution tag, and BTRF form

Sign BTRF form (if being used)
- Not used for each transfusion
- Paper vs electronic records

Begin transfusion and monitor patient
- Monitoring procedures
- Training and knowledge of identifying and responding to reactions
- Procedure and communication of those who have a reaction

Does patient have a reaction?

NO → Document and continue routine care
YES → Document complete follow-up procedures

Discussion

The 50 RCAs and 3 aggregated reviews were separated into 7 event types: patient identification, blood orders, wrong blood, blood labels, consent, crossmatch, and transfusion reactions. Twelve root causes crossed over within the event types. The 4 root causes with the highest occurrence were: training/knowledge, technology barriers, lack of a formal process, and communication barriers. To understand the potential reasons behind these variations, VHA publications were examined. These documents are used by each facility as a guide to create blood transfusion protocols, procedures, and audit criteria.[24,25,26,27,28] They give the foundation for facilities to build upon; however, they do not give instructions on all or how to create processes for the systems throughout the blood transfusion process.[24,26] Each facility is responsible for ensuring processes are created, communicated, documented, and used.[24] This supports limited standardization within the VHA blood transfusion process.

The basic process map for blood transfusions is delineated in **Figure 3**. Flow, decision points, steps, and potential gaps are determined by the VHA publications and information from the RCA data. These are the critical steps from patient verbal consent to end of procedure. The process contains various points where differential variations may occur between all facilities; **Figure 3** expresses these differences or gaps. A crucial component of this process is proper identification of the patient. Within the RCAs, there were multiple reports of a facility not requiring, or there was no local policy requiring, two-person identification. These were more apparent within the patient identification and blood label event types. The most common action in response was to create or update local policies and procedures. Two-person identification requirements are proven to reduce transfusion errors at multiple stages of the process.[19,29] Failure to do two-person identification of blood bank specimens and before transfusion are common, preventable errors within the process.[30]

Based on the information from the VHA publications and RCAs, the greatest inconsistency between facilities is the use of patient identification software. This software is similar to the medication barcode administration system. Each piece associated with the transfusion process is scanned into the system for verification: patient ID blood band, blood bags, caution tags, and all forms with a barcode. While this technology decreases errors of misidentification, it is not available to all facilities.[26] One nurse that was interviewed indicated having this software at their facility would decrease any misidentification, as seen at other VAs. The gaps within the process create potential portals for adaptations or workarounds to individual tasks or larger processes.[31] Knowledge and training about these factors either increases or reduces the chance of an adaptation being used: IT tools, non-IT tools, tasks, processes, internal environment, organization, and management.[31]

There were reported cases within the RCA data where the computer system within facility blood banks could be bypassed, outside of an emergent situation, although all blood products must be logged in using the blood bank computer system. This occurred more often during emergent events. At this time, there were also complex processes in play and staff were unaware of how quickly and correctly to issue blood. There was one instance where staff were unaware of a function within the system. The RCA resulted

from the incorrect use of fresh frozen plasma (FFP). A safety check function for FFP was discovered post-safety event. This brings to light the depth of training staff receive on and off the job.

One of the root causes for patient identification errors, shown in **Table 2**, was inadequate training. The theme was apparent in the RCAs in relation to EHR use, blood bank software, specimen labeling, how to put in a blood order, understanding the difference between blood components, and verification procedures. Insufficient training and education are problems that lead to preventable errors.[19] Education and retraining creates classwide reflection about patient safety and safety goals.[32] Providing proper knowledge is vital to reduce errors. A reported event occurred due to lack of knowledge about universal blood types. The common universal donor is O-negative; however, this pertains only to red blood cells.[8] The universal plasma donor is of AB blood type.[8] The technician was issuing a blood order for FFP, and the patient's blood type was unknown. Instead of getting AB-positive blood, the technician grabbed O-negative. When this information is not taught, posted, or retained, it can lead to fatal consequences. One site added a sign with the universal blood types on the blood bank refrigerators. Another created a cognitive aid with the blood types and compatibility between them. Training should be standard to include the utmost vital information. The correct method for blood transfusions should be laid out in a diagram and explain potential side effects.[33]

The RCA overviews lead into communication issues. One RCA described their policies to be "vague and verbose." Inconsistent information sharing, poor communication processes, and untimely hand-off communication are recurring issues. Poor communication most often occurred between differing clinical specialties and/or departments, as seen in **Table 2** under blood orders. There was lack of communication between the medicine and spinal cord injury (SCI) services and between those services and the blood bank. Communication issues within other RCAs occurred between nurse/physician, resident/blood bank technician, ED/inpatient unit, phlebotomist/blood bank technician, and nurse/phlebotomist. A warm hand-off is a required standard of care for patient safety.[34] Inconsistencies and questions about care plans are approached and solved during the hand-off. Evidence of teamwork and collaboration between healthcare professionals demonstrates positive health outcomes.[35] Continuous effective teamwork and communication reduces medical errors, costs, and waste, and improves safety, efficiency, anxiety, problem-solving, and quality of care.[36] Communication and teamwork may be enhanced through an audit-feedback loop. When both monthly team and individual audits and feedback were completed, compliance improved.[37] One site used this method to help staff learn about massive blood transfusions through training simulation (**Table 2,** wrong blood). They incorporated a debrief portion during the simulation and after real-life events. This same team also implemented a time-out upon delivery of the blood product to improve communication and verification of patient, blood type, and compatibility. Other RCAs resulted in creation of timeouts and simulation events as well.

These RCAs show how facilities have different policies, procedures, training availability, resources, and technological access. One of the most common actions was to revise or create local policies along with standardizing processes within the facility. However, there still remain differing processes throughout the

entire VHA. True standardization would allow an individual to switch from hospital to hospital and be able to tackle the job as they did at a previous location. Safe transfusion relies on 100% compliance to standard operating procedures (SOP) and checklists.[38] Standardization of the blood transfusion processes and use of a transfusion bundle may reduce errors. The World Health Organization's High 5s project defines process standardization as "the specification and communication of a process at a level of detail sufficient to permit consistent and verifiable implementation by different users in different settings."[39] This project aims to standardize processes not only within countries, but across countries. The project will aid in production of systematic designs for continuous improvement, local adaptations, and varying implementations without modifying the SOPs.[39] Standardization may be reinforced by using a transfusion bundle. Borgert et. al. observed a reduction of inappropriate transfusions and improved compliance with transfusion protocols when the bundle was used.[29] Safety is not a competition, but a coordinated maneuver.[40]

Recommendations

The following recommendations are correlated with the weaknesses found within the blood transfusion processes, as seen in **Figure 3**. These are based on the RCA outcomes and available research to reduce errors within health systems.

1. Enhanced, standardized, timely training and educational seminars with appropriate supplemental materials (e.g., simulation training with checklists for practice massive blood transfusions)

2. Enhanced and encouraged communication between VHA facilities (e.g., compare processes and uses of technology; perhaps one facility has ideas another could implement)

3. Enhanced communication within individual facilities (e.g., communication of patient identification and blood orders between lab and/or care team)

4. Review of accessibility of data and resources (e.g., place SOPs in a prominent location for staff)

5. Reporting becomes a healthcare standard—available to all at various site locations (e.g., similar to all adverse and sentinel events, all close calls will be reported)

6. Standardization of processes, protocols, communication, and training throughout the VHA in its entirety (e.g., training for a massive blood transfusion and protocol can be the same for each VAMC)

Limitations

RCAs do not include a full background of the patient information: underlying illness, history of treatments, surgeries, etc. However, the team involved in the RCA has access to the patient's full chart in order to reach the appropriate root causes(s). RCAs only come from reported events. Only those safety events reported are represented. The interdisciplinary team invited to attend the RCA is solely responsible for determining the causes, solutions, and ways for implementation. A similar event may be interpreted differently at another site. Outcomes from actions are monitored

and tracked at the discretion of the PSM from each facility. These outcomes are not inputted into the RCA database; therefore, the efficacy of the actions cannot be commented upon or shared.

Conclusion

The data presented in this study regarding blood transfusion within the VHA lists the building blocks needed to bridge patient safety, process development, training, communication, and standardization. Enhanced standardization within the blood transfusion process may decrease patient safety events. Collaboration and communication between facilities will allow each to apply techniques from other locations to their own. The National Patient Safety Foundation *Free From Harm* report states initiatives to improve healthcare stall due to inadequate collaboration.[40] In order to charge into the realm of greater patient safety and quality improvement, everyone within healthcare systems must collaborate, communicate, and standardize the systems and processes currently in place.

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