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Research Brief

# Identification of Transfusion-Associated Circulatory Overload: An Eye-Tracking Study

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**KEYWORDS**
transfusion-associated circulatory overload (TACO);
nursing;
eye tracking;
surveillance;
hemotherapy;
biovigilance;
blood transfusion;
adverse event

**Abstract**

**Background:** The identification of transfusion-associated circulatory overload (TACO) relies heavily on the nurse's surveillance activities. Eye tracking can provide important information about nurses' surveillance behaviors as they carry out the blood transfusion process. The purpose of this study was to describe the eye movements of nurses who successfully identified TACO.

**Sample:** A convenience sample consisted of 20 acute and critical care nurses.

**Method:** An observational descriptive study using eye tracking was carried out in a simulated clinical setting.

**Results:** The TACO identifying nurses had the longest duration of eye fixations on the nursing shift report, infusion pumps, bedside monitor, and documentation flow sheet. The shortest duration of eye fixations was on the patient and blood product label.

**Conclusion:** Our findings suggest that the nursing shift report was a key source of data for the TACO identifying nurses, lending support to the need for accurate and complete handoffs between nurses.

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## Background

Transfusion-associated circulatory overload (TACO) typically occurs when a patient is unable to effectively process the fluid challenge associated with high infusion rates and/or blood product volumes administered, usually as a result of underlying cardiac, renal, or pulmonary pathology (Andrzejewski, Casey,

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& Popovsky, 2013). In addition to high mortality rates, TACO is associated with increased morbidity, length of stay, and hospital costs (Lieberman et al., 2013; Murphy et al., 2013). The identification of TACO relies heavily on the nurse's surveillance activities during the peritransfusion period.

**Key Points**

- Transfusion-associated circulatory overload (TACO) is associated with increased mortality, morbidity, length of stay, and hospital costs. The identification of TACO relies heavily on the nurse's surveillance activities.
- Eye tracking can provide important data regarding nurses' surveillance activities by measuring and recording their visual scanning patterns as they carry out a process. Visual scanning patterns include, but are not limited to, total duration of fixations on areas of interest and transitions between areas of interest.
- The eight nurses (40%) who identified a potential TACO event did so within an average of 4.5 minutes (range 2.3-7 minutes) into the simulation and had the longest total duration of eye fixations on the nursing shift report.

The negative consequences of TACO may be mitigated by early identification and appropriate intervention (Andrzejewski et al., 2013). Many transfusion-related adverse events, including TACO, go unrecognized (Lieberman et al., 2013; Thomas, Baffa, Nienhaus, & Hannon, 2012) and unreported (Narick, Triulzi, & Yazer, 2012; Raval et al., 2015). Strategies such as clinical decision support systems (CDSSs) have been recommended as means of improving nurse surveillance (Henneman, Gawlinski, & Giuliano, 2012). However, the development of these CDSSs will require greater knowledge about the surveillance behaviors of nurses who are successful in the identification of TACO.

Eye tracking can provide important data regarding nurses' surveillance behaviors by measuring and recording their eye movements as they carry out a process. Researchers have used eye tracking to evaluate and teach a number of safety-related processes, but not blood transfusion (Henneman, Marquard, Fisher, & Gawlinski, 2017). The premise underlying the use of eye tracking is that a relationship exists between where an individual looks and what the individual is attending to, thinking about, or concerned about at a given point in time. This ''eye-mind'' theory maintains that an individual's set of eye movements (termed visual scanning patterns [VSPs]) can provide insight into their cognitive processes as they carry out an activity (Duchowski, 2007; Just & Carpenter, 1980). VSPs include, but are not limited to, total duration of fixations on areas of interest (AOIs) and transitions between AOIs.

The VSPs of nurses performing complex activities such as blood transfusion have not been studied nor have the VSPs of nurses who are able to identify adverse events.

The purpose of this pilot study was to describe the VSPs of nurses who successfully identify TACO in a simulated clinical setting.

## Methods

### Design

An observational design was used to describe the VSPs of nurses who successfully identify TACO.

## Sample and Setting

After expedited review and approval from the university institutional review board, a convenience sample of 20 nurses with six or more months experience as an acute or critical care nurse were recruited for the study and signed a written informed consent. Participants were compensated with a $75.00 cash stipend.

The study site was the simulation center of a large east coast university-based college of nursing. The simulation scenario was developed based on the Centers for Disease Control and Prevention National Healthcare Safety Network Hemovigilance Module surveillance diagnosis classification for TACO (Centers for Disease Control and Prevention, 2013). The simulations were designed to run for a total of 30 minutes or until the participant stopped the blood transfusion, whichever came first.

### Procedure

On the day of the study, the participant was oriented to the simulated environment, the patient manikin, and the eye tracker equipment. The participant was then directed to care for the simulated patient as they typically would and to ''think aloud'' (i.e., verbally describe) as they provided care.

The patient was an 84-year-old female, with upper gastrointestinal bleed who was receiving her second unit of packed red blood cells in a 24-hour period. Her past medical history was significant for hypertension and rheumatoid arthritis. In addition to the packed red blood cells infusing at 100 mL/hour, the patient was also receiving crystalloids at 100 mL/hour.

The simulation began with the participant receiving a written change of shift report. Information included in the shift report included the patient's current status and past medical history (PMH), vital signs, significant clinical findings (i.e., new crackles at base of lungs), laboratory values, intake and output for the past 24 hours, and