



## Wrong-site nerve blocks: A systematic literature review to guide principles for prevention

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### ABSTRACT

**Study objective:** Wrong-site nerve blocks (WSBs) are a significant, though rare, source of perioperative morbidity. WSBs constitute the most common type of perioperative wrong-site procedure reported to the Pennsylvania Patient Safety Authority. This systematic literature review aggregates information about the incidence, patient consequences, and conditions that contribute to WSBs, as well as evidence-based methods to prevent them.

**Design:** A systematic search of English-language publications was performed, using the PRISMA process.

**Main results:** Seventy English-language publications were identified. Analysis of four publications reporting on at least 10,000 blocks provides a rate of 0.52 to 5.07 WSB per 10,000 blocks, unilateral blocks, or “at risk” procedures. The most commonly mentioned potential consequence was local anesthetic toxicity. The most commonly mentioned contributory factors were time pressure, personnel factors, and lack of site-mark visibility (including no site mark placed). Components of the block process that were addressed include preoperative nerve-block verification, nerve-block site marking, time-outs, and the healthcare facility’s structure and culture of safety.

**Discussion:** A lack of uniform reporting criteria and divergence in the data and theories presented may reflect the variety of circumstances affecting when and how nerve blocks are performed, as well as the infrequency of a WSB. However, multiple authors suggest three procedural steps that may help to prevent WSBs: (1) verify the nerve-block procedure using multiple sources of information, including the patient; (2) identify the nerve-block site with a visible mark; and (3) perform time-outs immediately prior to injection or instillation of the anesthetic. Hospitals, ambulatory surgical centers, and anesthesiology practices should consider creating site-verification processes with clinician input and support to develop sustainable WSB-prevention practices.

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## 1. Introduction

Wrong-site nerve blocks (WSBs) constitute the most common single type of perioperative wrong-site procedure reported to the Pennsylvania Patient Safety Authority, followed by wrong-level spinal procedures and wrong-site pain management procedures; this finding is consistent with other peer-reviewed literature [1,2]. The Authority is an independent state agency that collects and analyzes data reported through its Pennsylvania Patient Safety Reporting System (PA-PSRS) and then provides strategies and lessons learned to healthcare providers and organizations to improve safety and help prevent patient harm. PA-PSRS is one of the oldest and broadest state reporting systems in the United States [3] and contains more than 2.7 million reports [4]. Reporting incidents and serious events—events that caused or could have caused patient harm—to the Authority is mandatory, based on Pennsylvania's Medical Care Availability and Reduction of Error Act of 2002 [5].

From July 2004, when reporting began, through December 2015, 182 perioperative, regional anesthesia WSBs were reported through PA-PSRS, comprising 26.7% of 682 total wrong-site procedures reported during the same time period [1,6]. Of the WSBs that were reported from October 2014 through September 2016, 40% were performed by anesthesiologists and 60% by surgeons [1,6]. During this time period, the surgeons most commonly involved in wrong-site blocks were hand specialists, ophthalmologists, and orthopedists [1]. WSBs continue to contribute to the total number of wrong-site procedures reported in Pennsylvania despite the efforts of physicians and nurses, hospitals and ambulatory surgical facilities, and the Pennsylvania Society of Anesthesiologists and the Pennsylvania Patient Safety Authority, as well as national regulatory, accrediting, and professional organizations.

As part of a collaboration between the Pennsylvania Society of Anesthesiologists and the Pennsylvania Patient Safety Authority and to help promote WSB-prevention strategies, the authors conducted a systematic review of literature addressing WSB to identify the incidence, patient consequences, and conditions that may contribute to WSB, and to identify evidence-based methods to prevent them, as reported in the literature.

## 2. Methods

This systematic literature review followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) recommendations [7].

### 2.1. Search strategies

A medical librarian assisted with a search for published articles indexed through December 31, 2015, in the PubMed, CINAHL, and Embase electronic databases. Any publication addressing WSBs was eligible, except articles written on subjects other than humans or in languages other than English. Publications that were reviewed included research, commentaries, and guidelines. Searches included terms such as block, anesthesia, and incorrect or wrong side or site. Table 1 shows the full search strategies.

### 2.2. Data categories

After the medical librarian reviewed abstracts (when available) and publications (if no abstract was available) and excluded publications that addressed wrong-site surgery without specific mention of WSB and duplicate articles, 55 publications were identified for review. Two authors (ESD, RAY) independently conducted an initial publication review with 15 articles, then adjusted the data collection instrument and categories of data collected based on the nature of information available within the publications. For example, information about whether nerve blocks were performed for chronic pain or in association

**Table 1**  
Search terms for literature search.

Database searched	Search terms
PubMed	#1 "nerve block"[mh] OR "anesthesia, conduction"[mh] OR pain[mh] OR analgesia [mh] #2 nerve block* OR regional anesthesia OR regional anaesthesia OR anesthes* OR anaesthe* OR block* #3 "medical errors"[mh:no exp] OR "medication errors"[mh] #4 wrong site OR wrong side* OR incorrect site* OR incorrect side* OR correct site* OR correct side* #5 (#1 OR #2) AND (#3 OR #4)
CINAHL (Cumulative Index to Nursing and Allied Health Literature)	#1 (MH "anesthesia, conduction +") OR regional anesthesia OR anesthes* OR anaesthes* OR block* OR pain OR analgesia #2 (wrong OR incorrect OR correct OR misplaced) N3 (site* OR side*)
Embase	#1 'regional anesthesia'/de OR 'nerve block'/exp. OR 'analgesia'/exp. OR nerve-block OR nerve-blocks OR anesthes* OR anaesthes* OR pain #2 wrong-site OR wrong-side OR wrong-sided #3 incorrect NEAR/3 (side* OR site*) #4 correct NEAR/3 (side* OR site*) #1 AND (#2 OR #3 OR #4)

with surgical procedures was seldom provided, so this category was discarded.

The two authors then independently reviewed each of the 55 publications and excluded eight for lack of relevance (i.e., discussion of curriculum, discussion of anesthetic pharmacology, WSB mentioned as a topic for a panel presentation). An additional publication was excluded because it was an abstract, and a subsequent article based on the same data was identified and analyzed. An additional 24 publications were identified either as references in the original 55 publications, or from secondary sources identified by the authors, including online publications. In total, 70 publications were analyzed. Reviewers reconciled discrepancies by reviewing the articles together and discussing different interpretations until consensus was achieved. Data categories used in the data collection tool are presented in Fig. 1; data subcategories are described with the relevant results. Results are presented as descriptive statistics and analysis in the text and subsequent figures.

Data about the incidence of WSB were traced to the original document when possible, and only reported once in this systematic review (e.g., if an author referenced a previous author's report of WSB incidence, only the incident data from the original report was included).

## 3. Results

Of the 70 final publications, 46 were identified during the primary literature search and 24 from secondary sources. The number of publications was largest in 2011; the most common types of publications were peer-reviewed publications, followed by published abstracts (Fig. 2).

Thirty-three publications were based on data from hospitals, 13 on data from databases, and three (included in the previous numbers) were based on both sources. The remainder (i.e., 27) referenced data from other publications or provided no specific data. Most publications were studies or descriptive documents. Studies generally involved a hypothesis, collection and analysis of data, and a discussion. Abstracts for which subsequent peer reviewed publications were not identified comprised 18 of the 32 studies and 3 of the 24 descriptive publications (Fig. 3).

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