

# Incidence and Root Cause Analysis of Wrong-site Pain Management Procedures

## A Multicenter Study

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### ABSTRACT

**Background:** Medical errors exact an inordinate toll on healthcare costs. One of the most publicized and analyzed type of medical error is wrong-site surgery. Yet, despite the burgeoning number of procedures performed, no literature exists on wrong-site pain management injections.

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‡‡ When doctors hide medical errors. NY Times, September 9, 2006. Available at: [http://www.nytimes.com/2006/09/09/opinion/09sat4.html?\\_r=1&oref=slogin](http://www.nytimes.com/2006/09/09/opinion/09sat4.html?_r=1&oref=slogin). Accessed November 21, 2009.

§§ HealthDay News: Medical errors costing U.S. billions. Washington Post, April 9, 2008. Available at: <http://www.washingtonpost.com/wp-dyn/content/article/2008/04/08/AR2008040800957.html>. Accessed November 21, 2009.

|||| Medical Errors: The Scope of the Problem. Fact Sheet. Rockville, Maryland: Agency for Healthcare Research and Quality; 2000. Publication no. AHRQ 00-P037. Available at: <http://www.ahrq.gov/qual/erback.htm>. Accessed November 21, 2009.

The purpose of this study was to estimate the relative incidence and determine the causes of wrong-site pain management procedures.

**Methods:** Quality improvement records were examined during a 2-yr period from four civilian academic teaching hospitals, three military treatment facilities, and three private practices, for "sentinel" events involving wrong-site pain management procedures. A total of 13 cases (incidence 0.027%; 95% CI 0.01–0.05%) were identified from approximately 48,941 collective procedures of which 52.4% were deemed to be "at risk" for the occurrence. Root cause analyses were then conducted to determine the origin of each error.

**Results:** The 13 cases included five wrong-side transforaminal epidural steroid injections, six other wrong-side injections, and two wrong-level minimally invasive surgical procedures. In only one case was the "universal protocol" completely followed, and in nine procedures, multiple lapses occurred in protocol. Three patients had bilateral pathology, and in seven cases, the patient knew at the time that the wrong side was being injected. In no instance did any technical, legal, or professional consequences ensue from the error.

**Conclusions:** Wrong-site nerve blocks occur more frequently in pain management centers than has previously been acknowledged. Adaptation of the universal protocol to nerve blocks and strict adherence to widely accepted guidelines may prevent wrong-site interventional pain procedures.

### What We Already Know about This Topic

- ❖ Wrong-site surgery has garnered considerable attention and efforts to reduce its incidence
- ❖ The incidence and cause of wrong-site pain management have not been investigated

### What This Article Tells Us That Is New

- ❖ In a review of more than 48,000 pain management procedures, 13 wrong-site procedures were identified (incidence of 0.027%)
- ❖ In most cases of wrong-site pain procedures, multiple lapses in universal protocol were identified

**D**URING the past several years, the topic of medical errors has received considerable media attention.‡‡,§§ Besides the mortality associated with these mistakes, which may exceed 50,000 persons per year, the direct financial costs are estimated to be about \$17 billion per year, and the total costs more than \$35 billion.|||| Among all medical errors,

**Table 1.** Procedures Considered to Be “At Risk” for Wrong-site Sentinel Events

Procedures at Risk for Wrong-site Blocks	Procedures Not Considered at Risk
Unilateral transforaminal ESI	Interlaminar ESI
Unilateral selective nerve blocks	Caudal ESI
Unilateral peripheral nerve blocks	Trigger point injections
Unilateral facet blocks and radiofrequency	Intravenous infusions
Unilateral sacroiliac joint blocks and radiofrequency	Bilateral nerve blocks
Stellate ganglion blocks	Spinal cord stimulators
Unilateral lumbar sympathetic blocks	Intrathecal trials and pumps
Vertebroplasty and kyphoplasty	Celiac plexus blocks and neurolysis
Discography	Superior hypogastric plexus blocks and neurolysis
Intradiscal procedures	Ganglion impar blocks and neurolysis
	Acupuncture

ESI = epidural steroid injections.

perhaps no medical error has captured the public interest more than wrong-site surgery.<sup>##,\*\*\*</sup>

There is no nonsurgical procedure equivalent to a wrong-sided operation. However, one of the closest analogs may be wrong-site nerve blocks. A MEDLINE literature search revealed only a solitary report documenting two wrong-site anesthetic nerve blocks,<sup>2</sup> although a recent review of several databases revealed that wrong-site anesthesia-related adverse events may be more common than the published literature suggests.<sup>†††</sup> With respect to wrong-site pain management procedures, no reports were identified. Therefore, the objectives of this case series are threefold: to estimate the incidence of wrong-site pain management interventions, to perform a root cause analysis so that commonalities can be identified, and to publicize this issue so that steps can be enacted, which might prevent future occurrences.

## Materials and Methods

Quality improvement records were reviewed from pain clinics at 10 institutions during a standardized 2-yr period from 2007 to 2009 to identify “wrong-site” procedure sentinel events. These institutions included four academic teaching hospitals, two military teaching hospitals, one nonacademic military treatment facility, and three private practices. Because wrong-site procedures may be under-reported in non-mandatory reporting systems, all physicians at each practice were individually queried to determine whether any wrong-site procedures might have been missed from quality improvement reports.

<sup>##</sup> Weintraub K: Surgeon operates on patient's wrong side. *Boston Globe*, July 3, 2008. Available at: [http://www.boston.com/news/health/blog/2008/07/surgeon\\_operate.html](http://www.boston.com/news/health/blog/2008/07/surgeon_operate.html). Accessed November 21, 2009.

<sup>\*\*\*</sup> Associated Press: Man dies after surgeon operates on wrong side of head. *FoxNews.com*, August 24, 2007. Available at: <http://www.foxnews.com/story/0,2933,294414,00.html>. Accessed November 21, 2009.

<sup>†††</sup> Barach P, Seiden ST, Morley J: Wrong-site anesthesia adverse events: Can they be stopped? Presented at the Annual Meeting of the American Society of Anesthesiologists, October 19, 2008, Orlando, Florida, A773.

Billing records were examined at each nonmilitary institution during a 2-yr interval to estimate the total number of procedures performed. At military institutions where billing records were not available, the numbers and types of procedures were determined from procedure codes and scheduling records. When multiple distinct procedures (*e.g.*, sacroiliac joint and epidural steroid injection) were performed during a single visit, these were counted separately. For related or multilevel procedures that did not constitute an additional risk for the outcome measure (*e.g.*, multilevel facet blocks, multiple trigger point injections, and greater occipital nerve block plus pulsed radiofrequency), only the primary procedure was tabulated. Individual procedural reports were then examined during a 6-month period to determine the percentage “at risk” for wrong-site blocks. If the scope of practice was believed to have changed significantly during the 2-yr time frame (*i.e.*, turnover in practitioners or change in reimbursement) then a more in-depth examination that included cross-referencing these records with daily procedure schedules was undertaken to reflect these changes. Any unilateral block (*e.g.*, facet or sacroiliac joint) or spinal procedure in which correctly identifying the pathologic level was deemed to be critically important was considered as “at risk” (table 1). Causation was determined based on quality improvement records and “debriefings” conducted with the personnel involved in the event.

## Statistical Analyses

Categorical clinical data were described using the number of subjects and percentages. All cumulative percentages were calculated from primary data rather than mean percentages from subgroups. Confidence intervals were calculated for the number of at-risk procedures using data collected during 6 months. STATA software was used to determine statistical significance (StataCorp. 2007; Stata Statistical Software, Release 10; StataCorp LP, College Station, TX), and  $\chi^2$  testing was used to assess statistically significant differences in the number of at-risk procedures between the types of institutions. Fisher exact test was used to evaluate the difference between incidence rates for the three types of institutions. A *P* value less than 0.05 was considered statistically significant.

**Table 2.** Incidence of Wrong-site Injections Stratified by Institutional Classification

	Civilian Academic	Military*	Civilian Private Practice
Total No. procedures (wrong-site errors)	23,957 (n = 7)	14,926 (n = 2)	10,058 (n = 4)
No. at risk procedures (%; 95% CI)†	13,475 (56%, 55–57%)	6,681 (45%, 43–47%)	5,497 (55%, 53–57%)
Incidence of wrong-site errors based on total No. procedures (95% CI)‡	0.03% (0.01–0.06%)	0.01% (0.00–0.05%)	0.04% (0.01–0.10%)
Incidence of wrong-site errors based on at risk procedures (95% CI)§	0.05% (0.02–0.11%)	0.03% (0.00–0.11%)	0.07% (0.02–0.19%)

Cumulative column figures based on four civilian academic institutions, three military institutions, and three civilian private practices.

\*Includes two "academic" institutions, one of which has a residency program and the other a residency and pain medicine fellowship. † $P < 0.001$ . ‡ $P = 0.44$ . § $P = 0.58$ .

CI = confidence interval.

## Results

Based on the billing and scheduling records, an estimated 48,941 unrelated procedures were completed at the 10 institutions during the 2-yr time frame. A review of 500 billing records at different institutions, which were reconciled with daily schedules and electronic record review, showed six "duplicate procedures" or procedures that were not reflected in billing records, for an estimated error rate of 1.2%.

A total of 13 wrong-site procedures were identified, 12 from quality improvement records and one from staff physician query. The proportion of at-risk procedures at each participating institution ranged between 39 and 65% with the weighted average being 52.4%. On average, there was a lower percentage of at-risk procedures at the military pain clinics (45%) than that in the academic (56%) and private practices (55%;  $P < 0.001$ ). During the study period, the number of wrong-site procedures at each site ranged between 0 and 2. On the basis of the total number of procedures, the incidence of wrong-site blocks was estimated to be 2.7 occurrences for every 10,000 procedures (0.027%; 95% CI 0.01–0.05%). When only at-risk injections were used as the denominator, the incidence almost doubled to 5.1 occurrences per 10,000 procedures (0.051%; 95% CI 0.03–0.09%).

When stratified by the type of practice, the overall incidence of wrong-site procedures ranged from 1 in 10,000 (0.01%; 95% CI 0.00–0.05%) for military institutions, 3 in 10,000 (0.03%; 95% CI 0.01–0.06%) for civilian academic institutions, and 4 in 10,000 (0.04%; 95% CI 0.01–0.10%) for the three private practices ( $P = 0.44$ ). When only at-risk procedures were considered, these percentages increased to 3 in 10,000 (0.03%; 95% CI 0.00–0.11%), 5 in 10,000 (0.05%; 95% CI 0.02–0.11%), and 7 in 10,000 (0.07%; 95% CI 0.02–0.19%) for military, civilian academic, and private practices, respectively ( $P = 0.58$ ).

‡‡ A "time out" is a mandated pause before a procedure in which the patient, location, and type of procedure are identified by the staff physician and confirmed by a nurse and/or other designated personnel.

Among the assorted errors, five were wrong-side transforaminal epidural steroid injections, two each were wrong-side facet and intercostal nerve interventions, and two were wrong-level spine procedures (vertebroplasty and intradiscal electrothermal therapy). The other two wrong-site procedures were lumbar sympathetic and suprascapular nerve blocks performed on the incorrect sides (tables 2, 3).

In five of the 13 (38%) cases, either the side or level was not noted on the consent form. In four of the eight cases in which the consent form was correct, it was signed by a different provider than the one who performed the procedure. In one of these procedures performed on an inpatient, the consent form was never sent from the ward to the procedure area. A proper time out‡‡‡ was performed in the procedure room in six of the 13 (46%) cases, and the site was marked in only three (23%) cases. In 46% ( $n = 6$ ) of patients, bilateral or multilevel symptoms, scars on the contralateral side, or unusual anatomy contributed to the sentinel event (table 4).

No legal, professional, or procedural consequences ensued as a result of any error. However, the legal experts at two practices deemed the mistake a possible source of future litigation. In three (23%) cases, the patient requested and received rescindment of the bill. Seven (54%) patients had the correct procedure completed on the same day, whereas in two (15%) cases the physician refused to perform the second procedure out of concern for administering too much corticosteroid. Three (23%) patients elected to have their follow-up procedure performed by another physician.

## Discussion

This case series provides an in-depth analysis of a problem that has thus far been ignored in the pain medicine literature: wrong-site interventional procedures. A review of these cases reveals no universally common denominator for the mistakes, although several trends do emerge.

First, these cases can occur in any setting but may be more frequent when responsibility for the safe performance of a procedure is shifted between multiple providers. Second, in all but four cases, multiple steps in the universal protocol were

**Table 3.** Demographic and Relevant Clinical Information Pertaining to Wrong-site Interventional Pain Treatment Procedures

Wrong-site Error	Patient Information	Consent	Time Out	Site Mark	Prep and Drape	Causative Factors	How Discovered	Comments
Right LSB instead of left	51-yr-old woman with bilateral neuropathic pain. Received sedation.	Side not noted by HS who obtained consent	Done before entering procedure room	No	Both sides prepped but right > left	1. Attending not present for TO 2. No communication between staff and HS 3. Right side prepped > left 4. Surgical scars on both legs	Staff MD noticed when checking temperature in recovery area	X-ray technician and HS stated they knew at time. Patient also knew right side was done but thought this was standard. Patient requested not being billed for procedure. Procedure completed on correct side
T12 and L1 vertebroplasty instead of L1 and L2	55-yr-old woman with compression fractures. Received sedation.	Levels not noted	Yes	Yes	Appropriate	Error in counting vertebral bodies	Months later on MRI after her pain recurred	Received excellent pain relief for several months. Had repeat procedure elsewhere
Left L5-S1 TFESI instead of right side	43-yr-old woman with radiculopathy	Done by different doctor	No	No	Wrong side	1. Consent not checked 2. No TO 3. Wrong side prepped 4. Chart or patient not consulted about symptoms 5. Staff not in room at start of procedure	Staff entered room after HS placed needle in foramen. Patient knew at time wrong side was being done	Medication not injected on wrong side. Procedure completed on correct side
Right lumbar facet joint n. block instead of left	38-yr-old woman with LBP and severe scoliosis. Received sedation	Yes	Yes	Yes	Both sides	1. New HS inserted needle in wrong fluoroscopy view 2. Severe scoliosis 3. Bilateral prep and drape 4. Staff not in room at start of procedure	Staff entered room after first needle placed	Procedure completed on correct side
Right suprascapular n. block instead of left	25-yr-old woman with frozen shoulder	Yes	Yes	No	Wrong side	1. Prep by staff interrupted by page. When staff returned, wrong side prepped and draped	Noted by staff in procedure room when patient did not get better	Patient reconsented in room and correct side done
Right intercostal n. block instead of left	72-yr-old man with postthoracotomy pain	Yes	Yes	No	Both sides prepped and draped	1. Both sides prepped 2. Patient had pain and scar on both sides	Noted in postrecovery area by staff	Patient had relief of right-sided pain. Was reconsented and had block done on left side
Right L5-S1 TFESI instead of left	65-yr-old man with radiculopathy	Side and level not noted. Done by NP	No	No	Wrong side prepped and draped	1. Poor communication between NP and doctor 2. Multiple lapses in UP 3. New doctor in busy practice	At follow-up procedure, patient asked if left-side was going to be done this time	Review revealed wrong side was injected. Patient refused to pay copay and bill was rescinded
Right L4-5 TFESI instead of left	67-yr-old woman with radiculopathy	Side and level not noted. Done by NP	No	No	Wrong side prepped and draped	1. Poor communication between NP and doctor 2. Multiple lapses in UP 3. New doctor in busy practice	After injection, patient asked if another injection would be done on left	Doctor refused to inject other side because of concerns over steroid dose. Patient refused follow-up with same doctor (continued)

Table 3. Continued

Wrong-site Error	Patient Information	Consent	Time Out	Site Mark	Prep and Drape	Causative Factors	How Discovered	Comments
Left L4–5 TFESI instead of right	39-yr-old woman with radiculopathy	Yes, by NP	No	No	Wrong side prepped and draped	1. Poor communication between NP and doctor 2. Multiple lapses in UP 3. Doctor felt "rushed" by patient desire to finish quickly	Patient brought error to doctor's attention in recovery area	Only injection among many past and future ones that failed to provide benefit
Left L4–5 TFESI instead of right	54-yr-old woman with radiculopathy	Yes, by NP	Yes	No	Wrong side prepped and draped	1. Patient scheduled for wrong-side 2. Side not confirmed with patient during TO	In recovery area, patient asked why procedure was done on left	During TO, patient concurred with wrong-side procedure. Doctor refused patient request to inject other side because of concerns over steroid dose
L4–5 IDET instead of L3–4	44-yr-old man with axial back pain. Received sedation.	Level not noted	Yes	No	Appropriate	1. Patient had transitional anatomy 2. Different doctor performed discography	Doctor noted level after electrode inserted but before heating	Electrode placed at correct level and procedure done same day
Right-side ICN radiofrequency ablation instead of left	43-yr-old man with postthoracotomy pain. Received sedation.	Done by different doctor and not sent down to OR	Done after epidural placed	No	Midline prep and drape covered surgical scar	1. Consent by different doctor and not viewed by performing doctor 2. Multiple lapses in UP 3. Epidural placed and dosed before radiofrequency	Patient informed nurses when he returned to ward	During TO, sedated patient concurred with wrong-side procedure. Correct side repeated later same day
Left cervical facet radiofrequency denervation instead of right	66-yr old man with neck pain. Received sedation. Patient had bilateral pain and underwent radiofrequency denervation on the opposite side 2 d earlier	Yes	No	Yes	Both sides prepped and draped	1. Discrepancy in notes as per which side was previously done 2. Patient uncertain about side during day of procedure 3. No TO done	3 mo later, patient wrote letter of complaint to hospital indicating he signed consent because he was "emotionally distraught"	Unable to ascertain which side was previously done by saved images. Risk Management waived charges. Patient declined follow-up

HS = house staff (resident or fellow); ICN = intercostal nerve; IDET = intradiscal electrothermal therapy; LBP = low back pain; LSB = lumbar sympathetic block; MD = medical doctor; MRI = magnetic resonance imaging; NP = nurse practitioner; OR = operating room; TFESI = transforaminal epidural steroid injection; TO = time out; UP = universal protocol.

missed.¶¶¶ Third, in only two cases was the site marked, which may serve as the most visible protection against this type of error. Fourth, bilateral pathology seems to increase the risk for wrong-side procedures, probably because it abolishes a key visual cue that might prevent such occurrences. Fifth, in eight (62%) procedures, patients acknowledged knowing that the unaffected side was being targeted at the time. Sixth, in six cases, a practitioner different from the injecting doctor obtained the consent. Finally, no legal or professional ramifications occurred in any cases, although attorneys at two practices determined

that the mistake could leave the practice vulnerable for future litigation.

There is a plethora of literature on the topic of wrong-site surgery, but there is a dearth of prevalence studies, most of which involved surveys. In one survey conducted by the American Academy of Neurologic Surgery members, 50% of respondents reported that they had performed at least one wrong-site procedure in their career.<sup>3</sup> Among the estimated 1,300,000 total spine operations, 418 were at a wrong-level with an estimated prevalence of 0.03%—strikingly similar to our estimated prevalence rate. In a similar study conducted in practicing Canadian neurosurgeons, Jhawar *et al.*<sup>4</sup> found that the prevalence rates of wrong-site lumbar spine surgery, cervical discectomies, and craniotomies were 4.5, 6.8, and 2.2 per 10,000 operations, respectively. In yet another survey

¶¶¶ The Joint Commission: Universal Protocol for Preventing Wrong Site, Wrong Procedure, Wrong Person Surgery. Available at: <http://www.jointcommission.org/PatientSafety/UniversalProtocol/>. Accessed November 21, 2009.

**Table 4.** Quality Improvement and Surveillance Data Stratified by Institution

Institutional Classification	Personnel Involved in Procedures	Frequency of QI	Mandatory Reporting	Error Incidence (Total/"at Risk"), %	Changes Made in Response to Errors
Military/academic 1	RN with X-ray training, staff MD, house staff	1st year: monthly QI in combo with Department of Anesthesia 2nd year: joint quarterly QI with affiliate	Yes, but previously not strictly enforced	0/0	New time out form must be annotated and witnessed in procedure room. Strict enforcement of reporting rules*
Academic 1	RN for sedation only, X-ray technician, staff MD, house staff	Monthly	Implemented after errors	0.04/0.06	Mandatory reporting of event. Time out must be annotated and witnessed in procedure room. RN checks that site is marked and side is noted on consent. Preprocedure checklist hangs on the wall of every fluoroscopy suite
Private practice 1	RN, X-ray technician, staff MD	Ad hoc	No	0.05/0.10	None
Academic 2	RN, X-ray technician, staff MD, house staff	Monthly	No	0.02/0.04	Patient must confirm site in procedure room
Academic 3	RN, X-ray technician, staff MD, house staff	Quarterly	Implemented after errors. Now uses institutional risk management system	0.05/0.12	Time out must be done with attending staff in room, site must be marked, and procedure is confirmed with patient. Implemented institutional risk management system
Academic 4	RN with X-ray training, staff MD, house staff	Monthly	Yes	0.02/0.03	Spinal level must be confirmed by both proximal and distal counting
Military nonacademic 1	RN with X-ray training, staff MD	Monthly	Yes	0.02/0.06	Time out mandated in procedure room
Military/academic 2	X-ray technician, staff MD, house staff (no fellow)	Monthly in combo with Department of Anesthesia	Yes	0.02/0.04	None
Private practice 2	Medical assistant with X-ray training, staff MD	Ad hoc +5 random charts per month	Implemented after errors	0.08/0.14	Attending confirms procedure and side with awake patient in room
Private practice 3	Medical assistant with X-ray training, staff MD	Ad hoc	No	0/0	Attending confirms procedure and side with awake patient in room†

Quality improvement meeting (QI) records include morbidity and mortality discussion.

\* Changes occurred during study period in response to a wrong-level percutaneous discectomy done before study period. † Implemented after errors at affiliated site.

MD = medical doctor; RN = registered nurse.

conducted in the American Academy of Orthopedic Surgery members, Wong *et al.*<sup>5</sup> found that 53% of respondents observed a medical error in the previous 6 months, with 5.6% involving wrong-site surgery. Similar studies conducted among American and international general surgical databases have yielded even lower occurrence rates, with prevalence rates ranging between 1 event per 32,500 and 113,000 cases.<sup>6,7</sup> Consistent with our series, most wrong-site surgeries involve operations performed on the wrong side, followed in descending order by wrong digit, wrong vertebral level, wrong procedure, and wrong patient.<sup>5,8,9</sup>

Despite the relative infrequency in which intradiscal and vertebral augmentation procedures are performed, two wrong-level cases were identified. Performing percutaneous

disc procedures and vertebroplasty at wrong levels may predispose a small percentage of patients to subsequent pathology at the same or adjacent levels, respectively,<sup>10–12</sup> but this is much less likely than after open spine surgery.<sup>13,14</sup>

For other types of procedures, the consequences of wrong-level nerve blocks are unknown. Our inquiries revealed at least a dozen cases whereby an epidural steroid injection was performed at an unintended adjacent level and several instances where unintended facet joint nerves were blocked or ablated. There is no consensus as to whether performing an epidural steroid injection at the level of most severe pathology or the level corresponding to the worst symptoms is more beneficial.<sup>15–17</sup> With respect to facet interventions, virtually all patients undergo multilevel proce-

**Table 5.** Steps to Consider for Preventing Wrong-site Errors

1. Full implementation of "Universal Protocol"<sup>9</sup>
2. Implementation of "TeamSTEPPS"<sup>†</sup> approach or similar system emphasizing teamwork and communication
3. Make reporting mandatory
4. Minimize personnel turnover during cases
5. Designate clear-cut responsibilities rather than overlapping duties
6. Avoid bilateral preparation and drape for unilateral procedures
7. Perform time out in the procedure room and confirm with awake patient before sedation is administered
8. Whenever possible, have relevant imaging studies available in room
9. Standardize "left-right" fluoroscopy orientation, and always confirm spinal level by counting from above and below
10. Take "extra" precautions in patients with unusual anatomy, bilateral pathology, and when patients with the same name or procedure are scheduled together

\* Agency for Healthcare Research and Quality. TeamSTEPPS<sup>TM</sup>: National Implementation. Available at: <http://teamstepps.ahrq.gov/>. Accessed November 21, 2009.

dures, with few studies providing explicit criteria defining which levels were targeted.<sup>18,19</sup> Because the basis for targeting a particular level for these procedures is unclear, we declined to include these as "sentinel" events.

In seven cases, an attempt to "rectify" the error was made by performing the correct procedure on the same day. Although this may mitigate damage to patient relations and possibly even the economic consequences, this path should be chosen only after carefully weighing the risks and benefits. The former include local anesthetic toxicity for high-volume blocks, excessive corticosteroid dosing, and the risks inherent in the procedures themselves such as hypotension (lumbar sympathetic blocks), bilateral pneumothoraces (intercostal and suprascapular nerve blocks), and bilateral weakness (transforaminal epidural steroid injection).

So how common are wrong-site pain management interventions and what can be done to prevent them? Without comprehensive database reviews, we have no way of knowing the exact incidence of wrong-site nerve blocks. However, based on the best published estimates of wrong-site surgery,<sup>6,7</sup> it is likely that the incidence of wrong-site nerve blocks is somewhat higher. This stems from several factors, including that the universal protocol has only recently been uniformly instituted for interventional pain management procedures,<sup>20</sup> and that these injections are frequently performed in off-site or remote settings with less people.

In terms of preventing this phenomenon, recent experience suggests that widespread adoption of the universal protocol can reduce but does not eliminate these sentinel events. Unique considerations for wrong-site pain management include the paucity and variability of ancillary personnel to confirm implementation of safeguards; a large number of procedures and rapid turnover rates, which may make the phenomenon of a noninjecting doctor or other healthcare practitioner obtaining the consent more common; a high incidence of symmetrical pathology; and the fact that patients are generally awake and lucid during the procedures. Patients with transitional anatomy, which is estimated to occur in between 4 and 30% of the population and may be more prevalent in patients with back pain,<sup>21</sup> and those with multilevel and bilateral pathology may be at higher risk for wrong-level and wrong-side procedures, respectively. The correct and affected side should ideally be confirmed with a lucid patient during the time out, but as our case series illustrates, patients should not be relied on as safeguards. The most frequently cited reason for the phenomenon of a patient not informing the doctor of the impending error was that the patient believed "the doctor knew what he was doing" (*i.e.*, the contralateral side was being used as a means to get to the ipsilateral site of pathology). Unlike surgery, whereby the intervention is usually performed at the site of pathology, in pain management procedures the target site is often remote from the affected body part (*e.g.*, sympathetic block or transforaminal epidural steroid injection for extremity pain; table 5).

Despite the mandatory adoption of the universal protocol in the United States, the evidence supporting its ability to reduce wrong-site errors has thus far been mixed.<sup>22</sup> Part of the reason why the number of wrong-site procedures has not declined more significantly may be increased reporting. Pronovost *et al.*<sup>23</sup> determined that the mere requirement for doctors to mark the operative side has not resulted in measurable improvements in patient outcomes and concluded that the emphasis should be on "process." In a recent multicenter international study by Haynes *et al.*,<sup>24</sup> the authors found that the use of a preoperative checklist that included a "sign in" before anesthesia induction, a "time out" before skin incision, and a "sign out" after surgery but before the patient leaves the room resulted in significant reductions in both mortality and inpatient complication rates. One of the byproducts of the surgical safety checklist was that it enhanced communication between team members, requiring input from the patient, surgeons, nurses, and anesthesiologists. A similar approach advocated by the Agency for Healthcare Research and Quality is the "TeamSTEPPS" method, which focuses on communication and teamwork.<sup>|||||</sup> As illustrated in our cases, open lines of communication and input from all team members, including the radiology technician, might have prevented several of the errors from occurring. In a large root cause analysis of 455 wrong-site surgical errors, communication problems were deemed to be the primary cause in 80% of cases.<sup>25,26</sup>

||||| Agency for Healthcare Research and Quality. TeamSTEPPS<sup>TM</sup>: National Implementation. Available at: <http://teamstepps.ahrq.gov/>. Accessed November 21, 2009.

There are several limitations to this study. These include the retrospective nature of the surveillance, the absence of any predefined designation of a wrong-site procedure, and the potential for under-reporting. With respect to the absence of any "predefined" designation, several cases were identified whereby local anesthesia was administered on the wrong side before the error was discovered. None of these were annotated in quality improvement reports. Had a standardized definition existed as to what constitutes a wrong-site procedure, we might have elected to include them. Under-reporting of these events can take on two different forms: intentional and unintentional. For unintentional omissions (*i.e.*, wrong-site procedures that are never identified by staff or patients), the only way to estimate the extent of this phenomenon would be to perform an in-depth, large-scale review of cases, replete with all notes and fluoroscopy images.

In summary, this manuscript describes 13 cases of wrong-site pain management interventions that occurred in three different settings at 10 institutions during the 2-yr period. Because our surveillance methods could not capture wrong-site events that were unrecognized by all involved parties or for various reasons went unreported, these cases almost certainly under-represent the true incidence. They also underscore the need for prospective studies designed to better elaborate the frequency of these mistakes and preventative measures designed to reduce this occurrence.

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