Wrong-site surgery in orthopaedics

Procedures performed at the incorrect anatomical site are commonly perceived as being relatively rare. However, they can be a devastating event for patients and doctors. Evidence from the United Kingdom and North America suggests that wrong-site, wrong-procedure and wrong-patient events occur more commonly than we think. Furthermore, their incidence may be increasing as NHS Trusts increase the volume and complexity of procedures undertaken in order to cope with increasing demands on the system. In previous studies from North America orthopaedic surgery has been found to be the worst-offending specialty.

In this paper we review the existing literature on wrong-site surgery and analyse data from the National Patient Safety Agency and NHS Litigation Authority on 292 cases of wrong-site surgery in England and Wales. Orthopaedic surgery accounted for 87 (29.8%) of these cases. In the year 2006 to 2007, the rate of wrong-site surgery in England and Wales was highest in orthopaedic surgery, in which the estimated rate was 1:105 712 cases.

Surgery performed at the incorrect anatomical site is relatively rare and entirely avoidable. However, it has potentially devastating consequences for the patient and surgeon.\(^1\)\(^3\) The most notable recent case in the United Kingdom was the death of a patient from renal failure after surgeons removed a healthy kidney instead of the diseased one.\(^1\) In the United Kingdom it is estimated that adverse events cost approximately £2 billion per year in additional hospital stays alone.\(^4\) In the year 2007 to 2008 the NHS Litigation Authority received 5470 claims related to clinical negligence and paid out £633.3 million. This figure includes both damages paid to patients and the legal costs borne by the NHS.\(^5\) Since the Litigation Authority’s ‘Clinical Negligence Scheme for Trusts’ policy began in April 1995, surgical specialties have been the leading source of clinical negligence claims\(^6\) (Table I).

Wrong-site surgery continues to appear in the national news headlines and capture the attention of the general public.\(^7\) The BBC reported Litigation Authority data that 40 patients had claims involving wrong-site surgery settled in the financial year 2005 to 2006.\(^8\) Worryingly, the incidence of wrong-site surgery in the NHS in England appears to be rising annually, with 27 cases settled by the Litigation Authority in the financial year 2003 to 2004 and 35 in 2004 to 2005. Over this period, the cost of settling those claims, including damages and legal costs, increased from £447 694 in 2003 to 2004 to £1 098 975 in 2005 to 2006.\(^8\)

A review of claims from the Medical Defence Union in 2002 found 306 claims relating to ‘wrong’ procedure, side, operating list, consent, patient name and notes. Of these, 119 (39%) were concerned with the wrong side and 20% occurred in orthopaedics. Almost half (49%) were in dentistry and involved removal of the wrong tooth.

In England and Wales, analysis of National Patient Safety Agency pilot data from 28 acute sites from September 2001 to June 2002 found 44 reported adverse events involving incorrect procedure, site, operating list, consent, patient name or notes,\(^9\) most occurred in orthopaedics. Of these adverse events, seven (16%) led to the wrong procedure being carried out. The

<table>
<thead>
<tr>
<th>Specialty</th>
<th>Number of claims</th>
<th>Total value of claims (£)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surgical</td>
<td>17 817</td>
<td>1 283 208</td>
</tr>
<tr>
<td>Obstetrics and gynaecology</td>
<td>9477</td>
<td>3 332 916</td>
</tr>
<tr>
<td>Medicine</td>
<td>7920</td>
<td>966 006</td>
</tr>
<tr>
<td>Accident and emergency</td>
<td>5056</td>
<td>450 111</td>
</tr>
</tbody>
</table>

Table I. NHS Litigation Authority information on total number and value of clinical negligence claims 01/04/1995 to 31/03/2008\(^8\)
Wrong-site surgery across the surgical specialties in England and Wales. Information from the National Patient Safety Agency indicates the high frequency of listing errors. Between October 2003 and November 2006 there were 855 incidents reported to the National Reporting and Learning System relating to erroneous details being included on operating lists. There were 323 incidents where the patient was listed for surgery on the wrong side, 195 for the wrong operation, and 110 where there were inaccuracies in the patient details. During 2007 this figure rose dramatically to 1136 errors, with one patient per day being listed for the wrong operation.

In light of this knowledge, the National Patient Safety Agency and the Royal College of Surgeons of England produced recommendations for surgical marking, along with a checklist to help staff verify that steps to promote correct site surgery were taken. In this paper we review the existing literature on wrong-site surgery and present information from the National Patient Safety Agency and NHS Litigation Authority regarding 292 cases of wrong-site surgery across the surgical specialties in England and Wales.

Materials and Methods
We obtained information on reported cases of wrong-site surgery in England and Wales from the national patient safety agency and NHS Litigation Authority. The Litigation Authority data, including categories relating to the surgical specialty in which the incident occurred were examined by one of the authors (PMR). Cases were also categorised by orthopaedic subspecialty. In order to quantify the rate of wrong-site surgery in England and Wales, we obtained NHS data detailing the total number of surgical procedures performed during consecutive years between 1998 and 2007 in England and Wales. These were combined with the data obtained from the NHS Litigation Authority for the corresponding period, thereby giving the estimated rates of wrong-site surgery for each year. In order to quantify the rate of wrong-site surgery for individual surgical specialties we correlated NHS Litigation Authority records for the year 2006 to 2007 and NHS records of operations performed during the same period in England and Wales.

Results
Incidents of wrong-site surgery in England and Wales. Information provided by the National Patient Safety Agency states that there were 79 wrong-site procedures reported to the National reporting and learning system since the Correct Site Surgery guidance was introduced (March 2005 to November 2007). The Learning System data indicate that anaesthetic blocks are the most common procedure occurring at the wrong anatomical site in England and Wales.

Other information from the safety agency gives us some idea of the level of harm caused to patients from reported adverse incidents associated with surgical procedures. Notably, there were no cases of death due to wrong-site surgery in this sample.

A key area that has been highlighted by the National Patient Safety Agency is the high frequency of listing errors. Between October 2003 and November 2006 there were 855 incidents reported to the National Reporting and Learning System relating to erroneous details being included on operating lists. There were 323 incidents where the patient was listed for surgery on the wrong side, 195 for the wrong operation, and 110 where there were inaccuracies in the patient details. During 2007 this figure rose dramatically to 1136 errors, with one patient per day being listed for the wrong operation.

Which specialties are the worst offenders in England and Wales? Information obtained from the NHS Litigation Authority on closed and open claims reveals a total of 292 procedures carried out on the wrong patient or anatomical site since the introduction of the Litigation Authority’s Clinical Negligence Scheme for Trusts policy in April 1995 (Table II). Orthopaedic surgery resulted in the largest number of claims. However, there is no mention of wrong-site anaesthetic blocks in the NHS Litigation Authority data. In view of their high incidence in the safety agency data, we must assume either that anaesthetic events have not been included in the Litigation Authority data, or that they may not have led to litigation. Readers should note that before April 2002, Trusts alone were responsible for the management and cost of claims below the clinical negligence scheme for trusts excess, which ranged from £10 000 to £500 000 per trust. Although some of these claims were notified to the NHS Litigation Authority for recording purposes, information on these claims is not included in Table II.

The most commonly affected subspecialty area in orthopaedics was hand surgery (21 cases), followed by foot and ankle surgery (18 cases) and spinal surgery (16 cases). The total amount paid in relation to the orthopaedic cases which have been settled was £2 252 752.58. The maximum paid for a single orthopaedic case was £564 600.70 which involved spinal surgery.
The data in Table III show that the occurrence of wrong-site surgery was highest in 2003 to 2004 and that the rate appears to have fallen subsequently.

Although the Litigation Authority data in Table II show that most incidents occurred in orthopaedic surgery, it fails to take into account the effect of caseload. In an attempt to clarify this, we used NHS records for the total number of surgical procedures carried out in the period 2006 to 2007 and categorised these by specialty. We combined this with NHS Litigation Authority records of incidents occurring in the corresponding period to give the rates of wrong-site surgery by specialty (Table IV). This confirms that orthopaedic surgery has the highest rates of wrong-site surgery when caseload is taken into account for this period, followed by neurosurgery and obstetrics and gynaecology.

### Discussion

We found that orthopaedics was the worst-offending surgical specialty in England and Wales with regard to the total number of cases and rates of wrong-site surgery in the period 1998 to 2007. This has worrying implications both legally and financially and raises an important patient safety issue within the specialty. The most-affected subspecialties within orthopaedics were hand surgery, foot and ankle surgery and spinal surgery. These trends have been described in other countries, particularly North America.13

Although this information gives some indication of the number of cases of wrong-site surgery in England and Wales, it probably leads us to underestimate the size of the problem. A review of serious untoward incident data from the Strategic Health Authorities revealed three incidents in March 2007 alone. Also, a recent report by the Chief Medical Officer for England and Wales refers to 14 cases of burr holes drilled on the wrong side in the last three years,12 and these are not all recorded in the data from the Litigation Authority and Safety Agency. A further limitation of this data is that it is unclear whether the procedures were completed, or at what stage the error was noticed and rectified. It must also be noted that in some of the cases where surgery was undertaken on the wrong side, it had been planned for both sides, for example cataract surgery.

Our study has several limitations and this information should be interpreted with caution. The data are subject to variation with trends in litigation and the reporting of incidents. Not all cases of wrong-site surgery will be subject to litigation, and therefore may not have been reported to the NHS Litigation Authority. However, one might expect them to be reported to the National Patient Safety Agency. Furthermore, there is a time lag between the incident and act of litigation. We therefore suggest that the rates in the later years will rise further and do not yet indicate the true rate of wrong-site surgery. The information about the total

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### Table III. Estimated incidence of wrong procedures in England and Wales by year

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of cases reported to NHS Litigation Authority</th>
<th>Number of surgical procedures performed</th>
<th>Risk of wrong procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998 to 1999</td>
<td>9</td>
<td>7 018 379</td>
<td>1.779 820</td>
</tr>
<tr>
<td>1999 to 2000</td>
<td>12</td>
<td>7 131 151</td>
<td>1.594 263</td>
</tr>
<tr>
<td>2000 to 2001</td>
<td>23</td>
<td>7 181 778</td>
<td>1.312 686</td>
</tr>
<tr>
<td>2001 to 2002</td>
<td>39</td>
<td>7 123 415</td>
<td>1.182 652</td>
</tr>
<tr>
<td>2002 to 2003</td>
<td>37</td>
<td>7 227 376</td>
<td>1.195 334</td>
</tr>
<tr>
<td>2003 to 2004</td>
<td>56</td>
<td>7 303 898</td>
<td>1.130 427</td>
</tr>
<tr>
<td>2004 to 2005</td>
<td>34</td>
<td>7 442 910</td>
<td>1.218 909</td>
</tr>
<tr>
<td>2005 to 2006</td>
<td>29</td>
<td>7 791 798</td>
<td>1.268 683</td>
</tr>
<tr>
<td>2006 to 2007</td>
<td>23</td>
<td>8 479 724</td>
<td>1.368 684</td>
</tr>
</tbody>
</table>

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### Table IV. Total procedures in England and Wales in 2006 to 2007 and cases of wrong-site surgery by specialty

<table>
<thead>
<tr>
<th>Specialty</th>
<th>Total procedures England and Wales 2006 to 2007</th>
<th>NHSLA* cases of wrong-site surgery for specialty</th>
<th>Risk of wrong-site surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orthopaedic surgery</td>
<td>845 692</td>
<td>8</td>
<td>1:105 712</td>
</tr>
<tr>
<td>General surgery</td>
<td>707 021</td>
<td>2</td>
<td>1:353 511</td>
</tr>
<tr>
<td>Urology</td>
<td>726 291</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Spinal surgery</td>
<td>86 230</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Cardiac and vascular surgery</td>
<td>234 245</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Obstetrics and gynaecology†</td>
<td>756 496</td>
<td>3</td>
<td>1:252 165</td>
</tr>
<tr>
<td>Ophthalmology</td>
<td>540 466</td>
<td>1</td>
<td>1:540 466</td>
</tr>
<tr>
<td>Neurosurgery</td>
<td>202 989</td>
<td>1</td>
<td>1:202 989</td>
</tr>
<tr>
<td>Thoracic surgery</td>
<td>31 613</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Breast and endocrine surgery</td>
<td>103 344</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

* NHSLA, NHS litigation authority
† excluding data for normal births

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number of surgical procedures performed in England and Wales for these periods is not guaranteed to be completely accurate and relies heavily on local coding practices. Consequently, it has been difficult to categorise certain procedures to a specific specialty and these figures provide only a rough estimate. However, the overall trends are expected to remain unchanged.

**Lessons from North America.** The subject of wrong-site surgery has been extensively covered in the surgical literature. The largest source of material has been North America, where orthopaedic surgeons have been at the forefront of tackling the problem. In the United States alone, medical errors in hospitals are thought to result in between 44 000 and 98 000 deaths per year, at an estimated cost to the government of up to $29 billion.¹⁴

In June 1994 the Canadian Orthopaedic Association published its position paper on wrong-side surgery in orthopaedics.¹⁵ The aims were to develop a reproducible method of operating on the correct side. This led to a large-scale education campaign from 1994 to 1996, the mainstay of which was the phrase ‘Operate Through Your Initials’. A similar awareness initiative, referred to as ‘Sign Your Site’ was introduced in 1998 by the American Academy of Orthopaedic Surgeons (AAOS).¹⁶,¹⁷ Following this, in 2001 the North American Spine Society developed the ‘Sign, Mark and Radiograph (SMaX)’ programme.¹⁸

The ‘Sign Your Site’ initiative was developed in response to an AAOS task force review of insurance records for 110 000 physicians of different surgical specialties between 1985 and 1995.¹⁹ The task force found that 225 of 331 (68%) claims of wrong-site surgery involved orthopaedic procedures. It also obtained detailed information about 37 claims made between 1977 and 1997 from the State Volunteer Mutual Insurance Company in Tennessee. The most commonly involved anatomical site was the knee and the most commonly involved procedure was arthroscopy.

In the United States wrong-site surgery is classed as a ‘sentinel event’ that is reported voluntarily to the Joint Commission on Accreditation of Health Care Organisations, which maintains a database and analysis of such events. The Joint Commission is an independent, non-profit making organisation responsible for accrediting and certifying many of the health-care organisations and programmes in the United States. Information about sentinel events is disseminated by the joint commission through ‘Sentinel Event Alerts’, so that health-care providers learn from and avoid repetitions. In December 2001 the Joint Commission issued a Sentinel Event Alert detailing wrong-site, wrong-procedure and wrong-patient surgery.²⁰ Of the 126 recorded events for which detailed information was available, 41% related to orthopaedic or podiatric surgery, compared with 20% for general surgery, 14% neurosurgery and 11% urology. Of the 126 events, 29% occurred in the operating theatre, 76% involved surgery on the wrong body part or site; 13% involved surgery on the wrong patient and 11% involved the wrong operation. The latest figures quoted by the Joint Commission in 2007 were nearly 550 events reported since 1996, stating that wrong-site surgery is now being reported at a rate of five to eight new cases per month, making it the most frequently reported sentinel event in the database.²¹ However, information from American states where it is obligatory to report wrong-site surgery suggests there is under-reporting of these events.²² The true incidence of wrong-site errors is difficult to define accurately owing to under-reporting,²³ the lack of a standard definition of what constitutes wrong-site surgery and the inclusion of near-misses in some estimates. Furthermore, some studies include only those cases which ended in litigation.²⁴ One could assume that these comprise only the most serious or damaging cases, resulting in an under-estimate of the true incidence of wrong-site surgery. Reported rates of wrong-site surgery in the United States range from one in 112 994²⁴ to one in 15 500 operations.²⁵

In Minnesota it is a legal requirement to report wrong-site surgery and these data are published annually. There were 35 reported events in 2006 to 2007,²⁶ resulting in one serious disability and no deaths. This had risen from 26²⁷ and 31²⁸ events in the previous two years. A recent study from Pennsylvania, where it is also required by law to report near-misses as well as cases of wrong-site surgery, estimated that for a 300-bed hospital, a wrong-site operative event (not a near-miss) would occur in the operating theatre once a year.²⁹ Another study of data from Florida estimated that the annual occurrence of wrong-site surgery in the United States is between 1300 and 2700 cases, with an estimation of one event per 51 540 surgical procedures in Florida.²³

**Errors in individual specialties.** There have been several studies concentrating solely on orthopaedic surgery alone. The AAOS task force estimated that an orthopaedic surgeon has a one in four chance of performing wrong-site surgery during a 35-year career.¹⁶

In a survey of active members of the American Society for Surgery of the Hand, 217 (21%) respondents reported performing wrong-site surgery at least once. A further 173 (16%) reported that they had prepared to operate on the wrong site but noticed the error before making an incision. The estimated incidence of wrong-site surgery among hand surgeons was one in 27 686 procedures.³⁰ A similar survey of the experiences of members of the American Association of Neurologic Surgeons estimated that the prevalence of wrong-level spinal surgery was one in 3110 procedures.³¹ Half of the surgeons reported that they had performed one or more wrong-level procedures during their career. However, the response rate was only 12%. A Canadian survey of neurosurgeons estimated the rate of wrong-level lumbar surgery to be 4.5 per 10 000 operations. Similarly, the rate of wrong-site cervical discectomies was 6.8 per 10 000, and for wrong-site craniotomies was 2.2 per 10 000.³²

The majority of studies show orthopaedic surgery as the worst-offending specialty.¹⁹,²³,²⁴ Several factors may have contributed to this phenomenon, such as a greater number
of orthopaedic procedures being performed than in other specialties and a greater opportunity for errors involving laterality where bilateral structures are involved. Other commonly cited specialties are anaesthetics, general surgery, dentistry, neurosurgery, spinal surgery, ophthalmology, urology and plastic surgery. However, case reports can be named from virtually any branch of health care. Risk factors for wrong-site surgery. Several studies have detailed the factors that lead to wrong-site surgery. From its analysis of sentinel events in 2001, the Joint Commission identified a number of factors contributing to an increased risk (Table V).

The root causes were reported as multifactorial. However, the majority involved a breakdown in communication between surgical team members and the patient and family. Other contributing causes included: policy issues, such as marking of the surgical site not being required; absence of verification in the operating theatre and of a verification process, which involves all documents and discussion with the majority involved a breakdown in communication between surgical team members and the patient and family. Other contributing causes included: policy issues, such as marking of the surgical site not being required; absence of verification in the operating theatre and of a verification process, which involves all documents and discussion with the patient to confirm the procedure and site. The participation of the anaesthetist in a preliminary ‘time-out’ in the operating theatre before the patient is touched would also contribute to a reduction in adverse events.

<table>
<thead>
<tr>
<th>Contributing factor</th>
<th>Proportion of cases (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emergency cases</td>
<td>19</td>
</tr>
<tr>
<td>Unusual physical characteristics, including morbid obesity or physical deformity</td>
<td>16</td>
</tr>
<tr>
<td>Unusual time pressures to start or complete the procedure</td>
<td>13</td>
</tr>
<tr>
<td>Unusual equipment or set-up in the operating room</td>
<td>13</td>
</tr>
<tr>
<td>Multiple surgeons being involved in the case</td>
<td>13</td>
</tr>
<tr>
<td>Multiple procedures being performed during a single visit to the operating theatre</td>
<td>10</td>
</tr>
</tbody>
</table>

A study of all wrong-site surgery cases reported to a large malpractice insurer in Massachusetts between 1985 and 2004 judged it unlikely that five (38%) of 13 non-spinal cases would have been prevented by the Joint committees Universal Protocol. Four of the 13 were judged to have been preventable by review of the radiological imaging or reports.
Some bodies have gone further in an attempt to combat wrong-site surgery. In Florida in 2001 the Board of Medicine instituted stiff penalties for physicians and organisations experiencing wrong-site surgery. They include fines up to $20,000, five hours of risk management education, 50 hours of community service and a one-hour lecture to the medical community on wrong-site surgery. As of July 2006, they had disciplined 45 physicians and three had each been fined $20,000.

The National Patient Safety Agency and the Royal College of Surgeons of England have led efforts in the United Kingdom to improve safety in this area. The Safety Agency has established the national reporting and learning system for the reporting of all adverse incidents. Since its inception there have been over two million patient safety incidents reports via the system. The system has several limitations. First, there is under-reporting of incidents compared with the data reported to strategic health authorities. Secondly, it may take several months (on average two) for incidents to be reported to the Safety Agency; and thirdly, not all incidents reported to the Learning System are individually investigated by the Safety Agency. This means that the follow-up of wrong-site surgery incidents in the United Kingdom has been ad hoc. This must be seen as a lost opportunity in terms of understanding and preventing wrong-site surgery. The National Patient Safety Agency has taken steps to rectify some of these problems. A rapid reporting system has recently been implemented to allow NHS organisations to report their most serious patient safety incidents more quickly.

One way in which patient safety could be improved would be to follow the example of some American states and make reporting of wrong-site surgery a legal requirement. This would lead to more accurate reporting and increase awareness of these events. Health professionals should be encouraged to report all adverse events, including near-misses, in a blame-free environment. It should be acknowledged that these mistakes can happen to the most respected individuals. All members of the team, irrespective of rank, should be encouraged to question actions in the operating theatre, and report adverse incidents. This last point is of particular relevance to a recent high-profile case in the United Kingdom. The reporting of all wrong-site surgery is vitally important, because without accurate information on its incidence and causes we cannot expect to learn from and reduce its occurrence.

The World Heath Organisation (WHO) has made procedures performed on the wrong patient or site one of its key areas for improvement in patient safety. The United Kingdom is taking part in the ‘Safe Surgery Saves Lives’ initiative to promote standard operating protocols in key areas of patient care. This recently resulted in the production of the WHO surgical safety checklist.

The patient’s role. Increased patient awareness of wrong-site surgery and personal participation in their operation could logically lead to a reduction in errors. Patient compliance with pre-operative site verification has been studied in foot and ankle surgery. One hundred consecutive patients were asked pre-operatively to mark the non-operative foot with the word ‘NO’ in black indelible marker pen. Only 59 complied fully with the instructions, four did something different from that which was instructed and 37 made no mark of any kind. Interestingly, 70% of patients with a workers’ compensation claim were non-compliant, compared with 33% of those without a claim. Previous surgery on the same foot was also found to be significantly related to non-compliance. However, all the patients complied with the instruction that they should fast from midnight before their surgery. Unfortunately, this study suggests that many patients continue to take a passive role where their treatment is concerned.

The use of technology. The use of technology to ensure correct-site surgery has generated some interesting solutions. A radiofrequency tag (SurgiChip, Inc., Palm Beach Gardens, Florida) has been developed which can be temporarily placed close to the operation site. The SurgiChip can hold information about the procedure, side and other patient details and is read using a remote radiofrequency sensor. Electronic patient wristbands have also been developed (Smart WristBand, CheckSite Medical, St Louis, Missouri) which contain a microchip that must be deactivated by the surgeon marking the operation site. A specific pen is required for site marking which includes a peel-off label that must be placed over the chip in order to deactivate it. If this is not done the chip triggers an alarm. These ideas are promising, but ultimately still prone to human error.

Wrong-site surgery is a serious but entirely preventable problem. In the United Kingdom its occurrence is more common than often appreciated by health-care staff and patients. The information we have presented illustrates the extent of wrong-site surgery across the surgical specialties and is likely to underestimate the true size of the problem. Orthopaedic surgery has the highest rate of wrong-site surgery in England and Wales, and we, as orthopaedic surgeons, must work to change this.

An AAOS bulletin report stated that “a successful legal defence to surgery performed on the incorrect limb is almost impossible.” Any incident of wrong-site surgery is unacceptable but by taking simple measures it is possible to reduce the incidence. Ultimately, the responsibility for correct-site surgery lies with the surgeon performing the operation, who should ensure that adequate precautions are taken to minimise the risk of such events.

Supplementary material Further tables showing details from the NPSA, NRLS and AAOS are available with the electronic version of this article on our website at www.jbjs.org.uk

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

References


