How effective is intraoperative communication in Winnipeg hospitals? A comparison of intraoperative diagnoses listed in pathology reports and operative notes

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ABSTRACT

Background: Diagnoses rendered during intraoperative consultations are acted on immediately and are highly dependent on verbal interactions between the pathologist and surgeon. Clear and efficient communication between the operating and diagnostic teams is critical in this setting, since any miscommunication may have an irreversible impact on patient care.

Design: We examined the concordance of intraoperative diagnoses recorded in pathology reports to surgeon-dictated operative notes as a result of verbal communications. Discrepancies between the intended communication by the pathologists and the interpretation by the surgeons were categorized by potential clinical impact: minor if the overall diagnoses were correct but contained minor inconsistencies with the potential to cause little to no clinical impact, and major if the overall diagnoses listed by the pathologist and dictated by the surgeon differed significantly and had the potential to alter intraoperative and/or postoperative patient management.

Results: 221 surgical cases with 578 frozen sections were examined. In 23% of the cases the intraoperative diagnosis was not recorded in the operative reports at all. Minor discrepancies were noted in 35% (59) of the remaining cases, and major discrepancies were recorded in 2% of the cases (3). Deferrals accounted for 24% of minor and 33% of major discrepancies overall. 54% of the minor and all major discrepancies were multipart cases. Two of the major discrepancies involved margin assessments, and one represented misinterpretation of the pathology diagnoses on some specimens of a multipart case. One of the major discrepancies led to a major negative impact on patient management where a margin was diagnosed and recorded as positive but interpreted as negative by the surgeon.
Conclusion: Our findings indicate that some verbally reported intraoperative diagnoses are miscommunicated and/or misinterpreted. In rare cases, this can lead to inappropriate intraoperative management. The study highlights the importance of auditing the intraoperative communication in local settings. Potential improvements may be achieved by educational sessions in multidisciplinary setting to address the communication gaps and developing professional guidelines for giving and receiving critical diagnostic information in intraoperative settings.
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INTRODUCTION

INTRAOPERATIVE CONSULTATION

A pathologist’s diagnostic legerdemain is considerably challenged during intraoperative consultation. In the setting of general pathology practice, a pathologist provides diagnoses on optimally processed, formalin fixed and paraffin embedded specimens in the days following a patient’s excisional procedure with the aid of subspecialized colleagues, unlimited reference material, and an apt timeframe to generate a final diagnosis and report. During intraoperative consultation, however, an anesthetized patient is open on the operating table with the outcome of their procedure to be determined by a small piece of tissue provided to the pathologist – while their surgical team waits for a diagnosis to direct their surgical actions and management of their patient.

The goals of intraoperative consultation are straightforward: provide an answer to a specific question posed by a surgeon in order to direct a patient’s intraoperative management and perioperative care. This may be accomplished by establishing the presence and nature of a primary lesion, evaluating the margins of a known malignant tumour, establishing evidence of invasion, or identifying lymph node or distant metastasis. 1,2,3 The pathologist must also ensure that tissue provided for intraoperative consultation is processed appropriately to be used in ancillary studies, such as lymphoma protocols, in the case of soft tissue sarcoma, or pediatric malignancies, and additionally must guarantee sufficient tissue is present for diagnosis on permanent section. 1,2 However, the reality of intraoperative consultation necessitates this process being completed in a compressed time frame – ideally twenty minutes or less, 1,2,4 but intraoperative consultation is more than just high speed pathology. Significant differences exist between general pathology practice and intraoperative consultation beyond the obvious time constraints, including study limitations, the unavailability of reference material, subspecialty consultation, diagnostic support of special
stains, immunohistochemical, and molecular studies, and often, the need for judicious interpretation of diagnostic findings due to these limitations.\textsuperscript{1,2,5}

**CHANGES IN INTRAOPERATIVE CONSULTATION OVER TIME**

Due to the evolving nature of medical oncologic treatment and the surgical management of specific malignancies, the reasons for which intraoperative consultation is requested and the specific question that it is addressing continues to shift.\textsuperscript{1} For example, in 2004 The United States Preventative Services Task Force issued recommendations for “annual screening for lung cancer with low-dose computed tomography in adults aged 55 to 80 years who have a 30 pack-year smoking history and currently smoke or have quit within the past 15 years.”\textsuperscript{6} This increase in screening led to an increase in the detection of smaller, low density lesions that are difficult or impossible for surgeons to palpate, in turn requiring thoracic surgeons to rely more heavily on intraoperative consultation for both establishing a diagnosis and evaluating surgical margins.\textsuperscript{1,7} On the other hand, the use of intraoperative consultation has significantly decreased in some circumstances, such as in the primary diagnosis of breast lesions.\textsuperscript{1} The percentage of breast specimens evaluated by frozen examination appears to have decreased significantly in the recent decades as new diagnostic modalities, such as core needle biopsy, have altered the clinical management of breast lesions.\textsuperscript{1,8} The active and evolving demand for intraoperative consultation not only highlights it as an established parameter of medical practice but also reflects the changes in the clinical questions related to advances in surgical treatment.\textsuperscript{9}

**INTRAOPERATIVE CONSULTATION METHODS**

A clear majority of intraoperative consultation is accomplished utilizing the technique of the frozen section. Other techniques, such as touch imprints or smears are also routinely utilized
but are not the focus of this study. Frozen section employs the use of rapidly freezing tissue and its intracellular water to create a hardened matrix that facilitates thin sectioning by rotary microtome, which can subsequently be applied to a glass slide and stained. Historically, freezing to harden tissues has been utilized since the early nineteenth century, with Pieter De Reimer pioneering the method of using frozen section technique for histopathological diagnosis in 1818. Over the next century, technical improvements continued, peaking with the development of the cryomicrotome, or cryostat, in 1959 which arguably revolutionized the frozen section technique and its practicality in intraoperative consultation. In a modern setting, tissue is submerged in an embedding medium applied to a metal surface, a liquid mixture that solidifies to a density similar to the frozen tissue, and is rapidly frozen to an optimal temperature using a heat extractor, cooling plate, or aerosol spray, and sectioned all within the cryostat before rapid, modified hematoxylin and eosin staining is applied, providing a pathologist with diagnostic material in approximately five to ten minutes. The technical advances and the variations of implementation among present-day institutions notwithstanding, the essentials of the preparation and reporting of a frozen section would remain recognizable to our predecessors. This has allowed frozen section to routinely guide the intra- and perioperative management of patients when pathologic information regarding lesions, their margins, or their near or distant invasion is requested for over a century.

LIMITATIONS OF INTRAOPERATIVE CONSULTATION

Even with exceptional diagnostic performance and keen awareness of limitations by the attending pathologist, frozen section diagnosis is not equivalent to the evaluation of specimens on permanent sections, predominately due to sampling error, technical issues, and interpretative fault. Sampling error is first encountered in the operating room, as pathologist interpretation is
limited to whatever tissue and orientation is provided for intraoperative consultation by the attending surgeon. In few institutions, the pathologist may be required to enter the operating theatre to oversee tissue selection for frozen section, but this is often unfeasible. Considerable cautery artifact may also be introduced by the surgeon at this stage of tissue sampling. Secondly, sampling error may occur due to poor selection of appropriate tissue by the pathologist at gross examination of the frozen section specimen. Other issues such as extensive tumour degradation or necrosis, secondary processes such as scar tissue, abscess, or granulomata, surrounding tissue reaction to tumour, or the focal nature of malignant cells – such as an immature component in a large ovarian teratoma – can further complicate accurate tissue sampling and impact the accuracy of intraoperative consultation.

Considering technical issues, ice crystals disrupt cellular structures in ways that are not reversed with thawing, creating often unavoidable permanent artifacts that may cause cell nuclei to appear larger and more variable. Similarly, defects created during cutting can mimic the presence of fat or vacuoles not truly present in the tissue in question. Soft tissues such as brain, adipose tissue, and many soft and friable neoplasms pose the chronic issue of freezing, processing, and cutting poorly, frequently resulting in limited interpretation of these tissues. Beyond this, other technical issues such as the thickness of tissue sectioning, tissue folding, and the quality and intensity of tissue staining all contribute to the overall quality of a frozen section slide and complicate diagnostic interpretation.

Finally, a major limitation in intraoperative consultation stems from pathologist interpretation, which is in turn heavily influenced by the limitations discussed above. In contrast to a standard surgical pathology case, in which anywhere from one to fifty or more permanent sections may be examined to reach a final diagnosis, a very small amount of tissue is examined
during intraoperative consultation. This may limit the ability of the pathologist to identify small, focal, or classically hard to diagnosis lesions,\(^2\) such as well differentiated angiosarcomas, signet ring cells in diffuse gastric carcinoma, or make the differentiation between chronic pancreatitis versus pancreatic carcinoma.\(^2,11\) Yet another challenge of interpretation is the absence of special histochemical and immunochemical studies that are required to definitively diagnosis certain entities such as the distinction of Paget disease from melanoma, Bowen disease from artifactual vacuoles, or, especially in the gastrointestinal tract, muciphages from signet-ring carcinoma.\(^12\)

Together, these limitations result in overall lower sensitivity and specificity of frozen section diagnosis in comparison to diagnosis made on permanent section alone, demonstrated in deferral rates (discussed below), in which a definite diagnosis cannot be made on frozen section alone,\(^1,13\) and an approximately 2% discordance rate between frozen section and permanent section diagnosis.\(^14–18\)

**DEFERRED DIAGNOSES IN INTRAOPERATIVE CONSULTATION**

In some circumstances, the specimen examined during intraoperative consultation cannot provide the pathologist with enough information to reach a diagnostic conclusion, resulting in a deferral of the diagnoses to permanent sections. There are five major sources of deferred diagnoses, beginning with specimens that include lesions which are typically difficult to classify as benign or malignant. A common example is the distinction between pancreatic adenocarcinoma and chronic pancreatitis, which may require the use of immunohistologic markers and more extensive cytologic examination on permanent section to render a final diagnosis.\(^1,19\) Other cases include distinguishing between lepidic predominant adenocarcinoma and reactive changes in lung tissue, such as reactive pneumocyte or atypical adenomatous hyperplasia,\(^1,20\) and the division of
residual or recurrent squamous cell carcinoma from radiation-induced atypia in squamous metaplasia.\textsuperscript{1,21}

A second source of deferral is biopsy induced artifacts, in which extensive crushing and/or cautery artifact causes tissue damage that obliterates diagnostic features and thus precludes interpretation on intraoperative frozen section. Particularly friable lesions, such as high grade neuroendocrine carcinomas (small cell carcinomas), are especially vulnerable to significant artifact and represent a majority of deferrals in this category.\textsuperscript{1} Thirdly, an intraoperative consultation may be deferred to permanent sections due to artifacts or tissue loss caused by poor processing. The selection of large or thick tissue fragments, poor cutting resulting in wrinkled or thick sections, or poor staining due to contamination of stains with xylene may significantly reduce the interpretive value of the microscopic slide produced. In some circumstances additional tissue may be available to repeat and correct processing, but if this is not feasible, a deferral may be the ultimate result.\textsuperscript{1}

Fourthly, if a specimen that is not amenable to frozen section examination, such as fatty tissue or heavily calcified specimens, deferral is appropriate.\textsuperscript{1} Finally, a lack of sufficient clinical information may also result in a deferred diagnosis. For example, a pathologist often requires information on imaging findings when evaluating bone and brain lesions intraoperatively. Similarly, information regarding prior neoadjuvant, adjuvant or radiation therapy is necessary to determine if atypical cells present in a specimen are more likely to be malignant or due to treatment-induced changes. Yet another case in which clinical history is essential to intraoperative diagnosis is the finding of thyroid follicles associated with lymphocytes and germinal centers in a neck lesion, which could be interpreted as metastatic carcinoma to lymph nodes, or as an area of nodular lymphocytic thyroiditis in an ectopic thyroid. \textsuperscript{22} A provided history of previous
malignancy easily shifts suspicion to metastasis, but without this information, a definitive conclusion may not be possible.

Two large scale College of American Pathologists (CAP) quality-probe studies reported 4.2% overall deferral rate in 1989 and 2.9% overall deferral rate in 1990. 23,24 A similar CAP study of smaller institutions, completed in 1994, reported an overall deferral rate of 4.6%. 25 To date, this data is considered an external benchmark by a majority of organizations and institutions. 26

APPROPRIATE UTILIZATION OF INTRAOPERATIVE CONSULTATION

Intraoperative diagnoses are one of the few times when a pathologic diagnosis can have an impact on the immediate medical management of a patient. For this reason, pathologists must be aware of the clinical consequence of diagnosis, and of their role in advocating for the patient in which the intraoperative consultation is being performed. 1,2,9 Some literature goes as far as suggesting that surgeons may regard frozen section as a convenience to satisfy their curiosity or to shortcut the longer timeframe of fixation and processing to obtain a definitive diagnosis. 9 Frozen section should be exclusively utilized as a management tool, not a diagnostic shortcut – if there is no intent to modify the procedure, the frozen section should not be requested or, if requested, not performed. For example, there is little use to perform a frozen section on a large tumour that is completely excised, and for which further surgery or treatment is not anticipated prior to a diagnosis based on permanent sections. In this case, the request for intraoperative consultation may be unnecessary, but it does not impede patient care. 1,2,9,11

In other cases, the request for intraoperative consultation may potentially confound a final diagnosis and is thus harmful to the particular patient. 1,2,9 For example, submission of a small lesion – such as a pigmented skin or breast lesion – for intraoperative consultation may require the
tissue to be frozen in its entirety. Some tissue loss will occur on sectioning, leaving little to no tissue for permanent section, and if freezing artifact or other technical issues obscure diagnostic features, a final diagnosis and appropriate diagnostic workup would not be possible. In this scenario, it is the responsibility of the pathologist to advocate for the patient by explaining to the attending surgeon that the patient’s interest – and ultimately the surgeon’s – would not be best served by performing a frozen section.1,2,9,11

Finally, there are some circumstances in which the specimen in question is already known to have low sensitivity or specificity, and there is therefore little value in performing intraoperative consultation.1,2,11 For example, the exclusion of vascular or capsular invasion in endocrine neoplasms, such as follicular carcinoma of the thyroid, is generally considered noninformative due to the focal nature of invasion, which is likely to elude detection due to limited tissue sampling inherent to frozen section evaluation.1,2,27,28 The evaluation of margins in large breast excisions,1 or in breast re-excisions to assess the presence of ductal carcinoma in situ at the re-excision margin2 are similarly noninformative. In the circumstance that intraoperative consultation is completed in these examples, the surgeon must be aware of the likelihood of a change in diagnosis on permanent sections.1,2 Beyond potentially impacting patient care, inappropriate use of intraoperative consultation additionally generates unnecessary workload and healthcare costs.1

ERRORS IN INTRAOPERATIVE CONSULTATION

Not surprisingly, errors made during intraoperative consultation align closely with its limitations discussed above, and can be made at the preanalytical, analytical, or postanalytical portion of the process. Preanalytical errors include incorrect case, patient, or site identification, inadequate clinical information provided by the attending surgeon, such as failure to inform the pathologist of a prior history of malignancy, neoadjuvant, adjuvant, or radiation therapy, or not
clearly delineating the purpose of the requested intraoperative consultation. Analytical errors include gross sampling errors, in which the lesion is not selected for frozen section upon initial examination of the specimen, or block sampling errors, in which the lesion is selected, but is not identified on prepared frozen section slides. However, it is important to note that that block sampling errors are sometimes unavoidable, such as the failure to detect a small (approximately 2-3 mm) lesion on frozen section that may require exhaustive permanent sectioning and the evaluation of numerous levels to identify. Analytical errors additionally may stem from technical issues, including poor freezing, cutting, or staining techniques, tissue loss during processing, or the mislabeling of slides. Finally, interpretive fault accounts for a major source of analytical errors, including errors that result in a change of category such as benign versus malignant, a change within category such as the specific type of malignancy, a change in threshold such as the differentiation between grade, stage, or disease process – for example, atypical ductal hyperplasia versus ductal carcinoma and situ in breast, or atypical adenomatous hyperplasia versus adenocarcinoma in situ of the lung – a change in lymph node status, or a change in margin status. Postanalytical error results largely from poor communication between the pathologist and surgeon, in which the diagnosis is not communicated, the wrong diagnosis is communicated, or the surgeon’s understanding of the reported diagnosis differs from what the pathologist intended to communicate.

Errors in intraoperative diagnosis are largely detected by correlation with final, permanent section diagnosis, a practice that is recommended for every case in which intraoperative consultation is performed, and which is a vital aspect of an institution’s quality assurance process, discussed in detail below. Considering the limited amount of tissue that can be submitted and sampled during intraoperative frozen section examination, and the reduced technical quality
of frozen sections in comparison to permanent sections, some errors in intraoperative consultation that result in discrepancies between intraoperative and final diagnoses are expected. Current literature reports discordance rates – defined as a diagnosis that differs on frozen and permanent section – ranging from 1.4% to 12.9%, with an overall median of 2.9%, a majority of institutions reporting discordance rate below 5%, and a majority of errors of the interpretive variety.

QUALITY MANAGEMENT IN INTRAOPERATIVE CONSULTATION

Quality control and assurance can be defined as “a set of planned and systematic activities focused on providing confidence that quality requirements will be fulfilled”. In the practice of pathology, ‘quality’ includes accuracy, reliability, completeness and timeliness of the reported test results. Successful quality management requires the identification of the processes at risk in all phases of testing, access to sufficient amounts of granular data for both individual pathologists and institutions in order to detect issues and trends, and once detected, determine whether issues are related to specific personnel, equipment, specimens, or specific steps in the process. Once the root cause of an issue is identified by thorough data analysis, improvement efforts, such as education and/or process redesign, can be implemented. Additionally, individual and institutional data can be compared to internal or external benchmark data to assess overall performance and identify trends over time. Finally, the continued monitoring of data subsequent to quality improvement efforts is necessary to determine if the issue has been successfully addressed, or if further interventions are required. Ideally, these activities result in a operational system that minimizes the chance of error and maximizes the likelihood of intercepting errors when they occur.

Comparable to the various limitations and errors discussed previously, the quality management of intraoperative consultation can be subdivided into preanalytical, analytical, and postanalytical phases. The preanalytical phase accounts for the lowest number of diagnostic errors
in this setting, but nevertheless includes multiple processes at risk for error worth monitoring and managing for improved quality. These include the provision of adequate clinical history to the pathologist by the surgeon, patient and specimen identification and tracking, designation of specimen orientation by the surgeon, and specimen handling and delivery time by surgical personnel. Documentation of the various interactions surgical personnel have through the frozen section process, and an ongoing working relationship with surgical quality improvement staff is necessary to decrease the occurrence of preanalytical errors.  

The analytic phase is arguably the phase of testing most in control of laboratory staff, but also results in a majority of diagnostic errors. This phase may be affected by analytic turnaround time, reagent and stain quality, equipment maintenance and decontamination, residual frozen tissue processing, specimen identification, intraoperative/final diagnosis correlation, and the collection and classification of diagnostic errors. Many of these processes are easily improved by identifying avoidable errors and applying quality improvement measures. The analysis of diagnostic deferral, agreement, disagreement, and adequacy rates, and the comparison of these rates with external and/or internal benchmark data is a cornerstone of quality management of the analytical phase of intraoperative consultation.

The postanalytical phase involves the reporting of the result once the diagnosis has been reached, a process that is negated if the result is miscommunicated to or misunderstood by the surgeon. As such, the entire process of communication is at risk for error. The impact that the postanalytical phase has on the overall quality of intraoperative consultation has been largely overlooked in the literature to date. More recent studies demonstrate that the rate of miscommunicated frozen section diagnoses is similar to the rate of the more widely recognized analytical phase problem of sampling error. Achieving quality communication during
intraoperative consultation is dependent on pathologists’ understanding of what information the surgeon requires to manage the patient, in addition to following clear and concise communication practices, and accurately documenting the result of the intraoperative consultation in the final pathology report. 30,33

In summary, the data collected, analyzed, and improved upon in the quality management plan at any given institution should ideally reflect the processes identified to be at risk for error in the preanalytical, analytical, and postanalytical phases of the multistep process of intraoperative consultation. 30 Concordance, discordance, and deferral rates are a major component of quality assurance, but are not a focus of this study. Figures 1a and 1b demonstrate an example of a tracking form used to collect relevant data for managing intraoperative consultation quality.
COMMUNICATION IN INTRAOPERATIVE CONSULTATION

The communication of diagnoses to surgical personnel is one of the most critical components of the complex, multistep process of intraoperative consultation. According to the Joint Commission, miscommunication among health care professionals accounts for approximately 80% of serious medical errors. A diagnosis rendered during a surgical procedure
often impacts immediate and frequently irreversible surgical decisions. Technical, sampling, and diagnostic errors notwithstanding, a miscommunication between the pathologist and surgeon – as a result of ineffective verbal communication by the pathologist, inaccurate transmission of the message, or misinterpretation of the message by the surgeon – may result in significant mismanagement of a patient, and in severe instances, could even lead to medicolegal consequences. Other specialty organizations, such as the American College of Radiology, have formulated guidelines and standards for communication in diagnostic radiology in attempt to minimize such errors, however the practice of pathology has not yet followed suit, requiring pathologists-in-training to acquire and refine their communication skills over time.

In a clinical setting, there are three cornerstones of successful communication: (1) the sender conveys the message in a clear and straightforward manner; (2) the receiver accepts the message and confirms that they have understood it; and (3) the sender verifies that the message was understood and received in the manner intended. In view of this, intraoperative diagnoses should directly address the question originally posed by the surgeon to successfully complete the procedure, be written and signed by the attending pathologist, read verbatim to the attending surgeon, and recorded and repeated back to the pathologist to ensure accuracy. Verbal communication is usually performed via telephone, intercom, or occasionally in person by the pathologist or resident. It is often an institutional requirement that communication take place directly with the attending surgeon, but in certain circumstances, may involve surgical trainees or ancillary surgical personnel. The attending pathologist should strive for absolute succinctness, avoid the use of abbreviations, eliminate superfluous information, avoid the use of terms indicating degree of certainty, and clearly distinguish differences between similar words. Long and wordy reports are
difficult to communicate verbally and run a higher risk of miscommunication and/or misunderstanding. Similarly, abbreviations may vary among clinical specialties – the interpretation of “c/w” as ‘consistent with’ versus ‘compared with’ significantly alters the interpretation of a diagnosis and runs a high risk for possible misinterpretation. Information such as the histological type or grade of the lesion in question is most commonly unnecessary and irrelevant to immediate surgical management, and if included, not only contributes to the risk of miscommunication but may also create potential discrepancies with the final diagnosis once permanent sections are examined and ancillary studies are available.\(^{37}\)

A final consideration is the use of the word ‘no’. It is highlighted in the literature that failure to transcribe ‘no’ or ‘not’ results in a final diagnosis that both makes sense and is inadvertently the exact opposite of what was originally intended (‘no carcinoma’ becomes ‘carcinoma’, or ‘no margin involvement is seen’ becomes ‘margin involvement is seen’, etc.) If the term ‘negative’ or ‘benign’ is used in the place of ‘no’, a missing word would result in a diagnosis that does not make sense, and provoke further investigation and likely, correction. This may sound like an improbable occurrence, but one institutional review reported eight incidences of the word ‘no’ being left out of a final intraoperative report over a five year period.\(^{38}\)

Possible communication errors do not begin and end with just the pathologist and surgeon, however. Intraoperative consultation is a complex, multistep process that includes communication feedback loops between the involved pathologist, surgical personnel, and technologists – and is thereby susceptible to errors at any one step or due to a combination of steps in the process, as depicted in \textit{Figure 2}. This communication workflow is further complicated in certain circumstances, such as intraoperative consultation that results in deferral, or when the surgeon
submits multiple specimens requiring frozen section analysis, and especially increase the chance of errors when communicating part-specific diagnoses. 31

LITERATURE REVIEW

While miscommunication among health care professionals accounts for the majority of serious medical errors, in anatomical pathology, in which the diagnostic language used differs significantly from general medical discourse, 34,37 the possibility for miscommunication is arguably heightened. Prior research has clearly established that significant communication gaps exist between pathologists and their clinical colleagues, particularly surgeons, which has the potential to involve key diagnostic information. 33,37 In the setting of general pathology practice, there is ample opportunity to resolve clinician misinterpretation of pathology data via additional review of the final pathology report, continued patient encounters, interdisciplinary conferences, and/or personal conversation, and thus, the ultimate consequence of any misunderstanding is often minimized before patient management is impacted. 32 Diagnoses rendered during intraoperative consultation, however, are acted on immediately and are often highly dependent on verbal interactions between the pathologist and surgeon or other surgical personnel. 1,31,32 As such, “there is no time [in the practice of pathology] when the fidelity of communication is more critical, and potentially problematic, than in the intraoperative setting”. 32

Major investigators such as the College of American Pathologists (CAP) acknowledge the significant impact intraoperative diagnoses may have on immediate surgical decisions, and as such, have thoroughly documented reliability, precision, and accuracy of frozen section utilizing correlation between intraoperative and final diagnoses, or examining turnaround time of frozen section analysis. 4,23–25,39 A majority of existing studies and quality assurance probes point to preanalytical and analytical issues, such as interpretative or gross sampling faults, as the sole sources of error in intraoperative diagnoses. 4,14,16,18,23–25,39,40 To this end, imperative intraoperative consultation practice parameters, such as concordance and deferral rates, recommendations, and
incorporation of these parameters into laboratory accreditation checklists is mandated by CAP
grounded on this accrued data,\textsuperscript{4,23–25,39} a majority of which focuses heavily on preanalytical and
analytical errors.

The substantial role that communication plays in the quality of intraoperative consultation
has not been demonstrated in the literature, and in turn, practice parameters to date. Few studies
make mention to postanalytical factors, such as clarity and effectiveness of pathologists’ verbal
communication with surgical personnel during procedures, or accurate comprehension of the
diagnosis by the surgeon.\textsuperscript{31,32} One single institution retrospective quality assurance study
examining the accuracy of frozen section diagnosis acknowledged that 9.5% of diagnostic errors
could be attributed to “lack of communication between the pathologist and surgeon”,\textsuperscript{16} but the
correlational model utilized by this and other existing large-scale investigations may not accurately
assess – or detect – postanalytical errors. A correct intraoperative diagnosis with perfect correlation
to permanent section and excellent turnaround time nevertheless has the potential to be
miscommunicated as a result of ineffective verbal communication by the pathologist, inaccurate
transmission of the diagnosis, or misinterpretation of the diagnosis by the surgeon, and may result
is significant mismanagement of a patient,\textsuperscript{1,31,32,41} including a patient requiring an additional
surgery, receiving inappropriate treatment, or critically impacting their prognosis.

Two recent studies explicitly examined communication during intraoperative consultation.
The first, by Talmon et al., sought to evaluate the accuracy of clinicians’ interpretation of the
outcome of verbal exchanges with pathologists. A retrospective review of consecutive
intraoperative diagnoses (n=1558) over a nine-month period was conducted in a large academic
medical center, comparing the intraoperative diagnoses listed in the final pathology reports with
those dictated by the surgeon. Discrepancies were stratified by potential clinical impact: category
A, overall correct diagnosis with minor unimportant differences; category B, discrepant diagnosis with both either benign or malignant; and category C, intraoperative diagnoses differing between benign and malignant.  

Category A discrepancies were noted in 94 (8.3%) cases, and Category B discrepancies in 11 (1.0%) cases. A majority of these minor discrepancies were inferred to be the result of surgeon being more specific or providing additional information in their operative notes that was not present in the pathologist’s written diagnosis, or the surgeon interpreting a deferred diagnosis as definitive. In 4 (0.3%) cases, category C discrepancies were identified, all of which were diagnosed as malignancies by the pathologist but miscommunicated to or misinterpreted by the surgeon as benign. Of these, a single case ultimately resulted in unsuitable patient management at the time of surgery, in which a diagnosis of “adenocarcinoma” was relayed to the surgeon via phone by a nurse as “no carcinoma,” and clear margins were not confirmed, nor obtained, at the time of the procedure. Finally, in 20% of cases, the outcome of the intraoperative consultation was not described by the surgeon in their operative notes.  

A similar study by Roy et al. strove to examine pathologist-surgeon communication during intraoperative consultation, utilizing a similar design of comparing pathologists’ communicated intraoperative diagnosis and the surgeons’ corresponding interpretation of this diagnosis (dictated in their operative notes) to identify discrepancies. Any discrepancy was considered a miscommunication, which was then critically reviewed and further classified as a “major” miscommunication if it had a significant impact on clinical outcome, or “minor” if it did not. Additionally, miscommunications were categorized into one of three groups: miscommunicating diagnoses involving numerical values, involving nonnumerical values, or specifically involving the grading of neoplastic lesions.
Of 300 consecutive cases reviewed from a single academic medical center, 8 (2.7%) miscommunications were identified, all of which had a minor clinical impact, and 7 of which took place on deferred cases. Among these cases, 2 involved the communication of numerical values, 4 involved the communication of nonnumerical values, and 2 specifically involved the grading of neoplastic lesions. All miscommunications were inferred to be caused by misinterpretation by the surgeon, however the authors noted that the use of verbose and/or nonstandard pathology terminology – such as “favours”, “about”, “versus”, and “scattered” – was observed in many intraoperative diagnoses that ultimately resulted in miscommunications. Similar to the previously discussed study, a minority of operative notes (8.3% of reviewed cases) did not include the outcome of the intraoperative consultation.\textsuperscript{31}

Due to their comparable designs, both studies are subject to similar limitations, namely, using operative notes as an overall assessment of communication quality. Additionally, the retrospective methods of review utilized are an indirect assessment of the surgeon’s comprehension of intraoperative diagnoses.\textsuperscript{32} It is possible that in certain circumstances in which postanalytical errors were identified, operative notes were dictated – and thus interpreted – by surgical trainees (intern, resident, or fellow) and signed off by the attending surgeon who did not share this incorrect interpretation.\textsuperscript{31} Similarly, the quality of operative notes is depended on the accuracy of the surgeon’s memory if they are dictated at a time distant from the procedure. Finally, uncorrected typographical errors in either the final pathology report or the operative notes may have functioned as confounding factor in some instances.\textsuperscript{32}

Limitations aside, these findings suggest that a subset of verbally reported intraoperative diagnoses are misinterpreted by surgeons, and in rare events, miscommunication may lead to inappropriate intraoperative management.\textsuperscript{31,32} All identified discrepancies, including
intraoperative diagnoses differing between benign and malignant, consisted of correct intraoperative diagnoses that correlated with permanent section diagnoses. Irrespective of their severity or the clinical impact these discrepancies ultimately caused, their presence suggests that postanalytical errors during intraoperative consultation may go undetected in standard quality control review. Other specialty organizations, such as the American College of Radiology, have formulated guidelines and standards for communication in diagnostic radiology in attempt to minimize such postanalytical errors, however the practice of pathology has not yet followed suite, requiring trainee pathologist’s to acquire and refine their communication skills over time.

To this end, the purpose of this study is to examine the concordance of intraoperative diagnoses recorded in intraoperative consultation pathology reports to surgeon-dictated operative notes in order to assess the accuracy of surgeons’ interpretation of intraoperative diagnoses as the result of verbal exchanges with pathologists in Winnipeg hospitals and analyze the discrepancies for potential clinical impact. This is first time that the clarity of pathologists’ verbal communication with surgeons during intraoperative consultation, and the surgeons’ resulting interpretations of intraoperative diagnoses is examined in this local setting. Assessing the efficacy of intraoperative diagnostic communication in Winnipeg hospitals allows us to identify previously unaccounted for postanalytical errors during intraoperative consultation, pinpoint any specific shortcomings in this area of clinical practice, develop new recommendations and guidelines regarding intraoperative communication, and ideally improve surgical management in cases where intraoperative consultation is required.
MATERIALS AND METHODS

This study was granted institutional approval by the University of Manitoba Health Research Ethics Board (#HS22054). Intraoperative diagnoses of 221 surgical pathology cases within 2018, recorded on specimen requisitions and included in the final pathology report, were obtained from the Laboratory Information System of three Winnipeg hospitals (Health Sciences Center, Grace General Hospital, and St. Boniface General Hospital). All intraoperative diagnoses were found to be correct on review of permanent section and/or random review by quality assurance, eliminating the possibility of an incorrect diagnosis being relayed to the attending surgeon.

All intraoperative diagnoses were rendered by licensed attending pathologists and conveyed to the attending surgeon over the telephone, face-to-face in the frozen section room, or over the telephone to other surgical personnel (surgical resident, clinical assistant, or perioperative nurse). Per provincial policy, pathologists were to record any gross evaluations, the diagnostic information provided to the surgeon or surgical personnel, and their signature on the specimen requisition. At time of grossing, this intraoperative diagnosis was dictated from the requisitions by pathologist assistants to be incorporated into the final pathology report. Operative reports were completed by surgeons within 1-30+ days of the procedure. Surgeons did not have access to related permanent pathologic diagnosis until final case sign out.

The following demographics were recorded from the specimen requisition and final pathology report: surgical pathology number and corresponding Medical Records number (for data audit purposes), procedure category (head/neck, skin, gastrointestinal, genitourinary, gynecological, soft tissue, skin, breast, or lung), the attending surgeon, the intraoperative pathologist, the verbatim intraoperative diagnosis or diagnoses, and the number of frozen section
specimens. Additionally, specimen requisitions were evaluated for two quality assurance parameters: whether the intraoperative pathologist documented the reporting of the intraoperative diagnosis to the surgeon or surgical personnel, and whether the specimen requisition was signed by the intraoperative pathologist.

The corresponding operative reports were obtained through the Electronic Patient Record system (Manitoba eHealth) by cross-referencing the Medical Records Number of the patient and the date of the procedure. A keyword search for ‘frozen’, ‘frozen section’, or ‘intraoperative consultation’ was used to search operative reports for relevant information. If these keywords were not found to be present in the text, the operative report was read in full to confirm the absence of a record of intraoperative diagnosis. The following information was recorded from operative reports: whether the intraoperative diagnosis or diagnoses were included in the operative report, and if so, the portion of the operative report referencing the intraoperative consultation, verbatim.

The diagnoses rendered by pathologists were compared to those dictated in the corresponding operative report for accuracy and overall content by a single reviewer (AM) over an eight-week period. Cases were further categorized based on their level of discrepancy. Cases were considered to have no substantial inconsistencies if the diagnoses dictated by the surgeon were identical to those listed by the intraoperative pathologist, contained a comparable amount of information, and made mention to all specimens in the circumstance of multipart cases. Cases were categorized as containing a minor discrepancy if the overall diagnosis were essentially identical and correct (both listed as benign or malignant, for example) but contained minor inconsistencies with the potential to cause little to no clinical impact.

Cases determined to contain minor discrepancies were further subcategorized based on the type of error: cases in which the operative report included more information than the recorded
intraoperative diagnosis, cases in which the operative report included less information than the recorded intraoperative diagnosis, cases in which diagnoses deferred by the pathologist were interpreted as definitive in the operative report, and cases in which the diagnosis was not correctly recorded in the operative report, without potential to cause major clinical impact.

Cases were categorized as containing a major discrepancy if the overall diagnoses listed by the pathologist and dictated by the surgeon differed significantly and had the potential to alter intraoperative and/or postoperative patient management. These included diagnoses differing between benign and malignant, margin status differing between positive and negative, or confusing diagnoses among specimens in the circumstance of multipart cases. Multipart cases were considered discrepant if a difference was identified among any of the diagnoses. In the case of major discrepancies, the patient’s clinical and pathologic history was evaluated (via Electronic Patient Records and the Laboratory Information System) for any indication of incorrect clinical management following discrepancy in intraoperative diagnosis.

RESULTS

Intraoperative diagnoses and corresponding operative reports of 221 surgical pathology cases, in which 578 frozen sections were performed, occurring within the designated timeframe were examined for concordance. The communication methods between the diagnostic and operative teams (phone, face-to-face, from pathologist to surgeon, resident or operating room personnel) were similar at the different sites.
The availability of clinical data is depicted in Figure 3. In 50 cases (23%), the frozen section diagnosis was not included in the surgeon’s operative report. Thus, comparison was possible in 171 cases.

![Figure 3. Availability of clinical data](image)

No significant inconsistencies between diagnoses listed in pathology reports and corresponding operative notes were identified in 108 (63%) of cases. Minor discrepancies were noted in 59 (35%) of cases, 32 of which were multipart cases. Three cases (2%) demonstrated major discrepancies, all of which were multipart cases.

Further stratification of the identified minor discrepancies, depicted below in Figure 4, revealed that 42% resulted from the operative report including more information than the recorded intraoperative diagnosis. For example, a frozen section diagnosis reported as ‘metastatic carcinoma’ interpreted and dictated by the surgeon as ‘metastatic high-grade adenocarcinoma’. Cases in which the operative report included less information than the recorded intraoperative diagnosis accounted for 30% of minor discrepancies overall. For example, an operative report...
which reads ‘no cancer’ reported by the pathologist on frozen section as ‘serous cystadenoma on these sections, malignancy cannot be excluded’.

Diagnoses deferred by the pathologist that were interpreted as definitive in the operative report accounted for 18% of minor discrepancies, for example, a frozen section diagnosis reported as ‘positive for malignancy, final typing deferred to permanent section.’ interpreted by the surgeon as ‘metastatic carcinoma from the stomach due to signet ring features’. The final 10% resulted from diagnoses not correctly recorded in the operative report without potential to cause major clinical impact, such as a frozen section diagnosis of ‘parathyroid tissue’ recorded as ‘parathyroid adenoma’ in the operative report.

Figure 4. Sources of minor discrepancies

Of the 25 deferrals encountered in this study, 56% resulted in a minor discrepancy and 4% resulted in a major discrepancy due to the surgeon failing to acknowledge the deferral and
interpreting any information provided by the pathologist as definitive. This accounted for 24% of minor and 33% of major discrepancies overall, as depicted below in Figure 5.

![Figure 5. Distribution of discrepancies in deferred cases](image)

Finally, specimen requisitions were evaluated for two quality assurance parameters. The intraoperative pathologist documented the reporting of the intraoperative diagnosis to the surgeon or OR personnel in 80% of reviewed cases. The specimen requisition was signed by the intraoperative pathologist in 93% of reviewed cases.

**CASES WITH MAJOR DISCREPANCIES**

**Case 1**

The first major discrepancy involved a margin status differing between positive and negative in the pathology report and operative note of a total laryngectomy procedure in which the
attending surgeon submitted three margin specimens for frozen section (trachea, base of tongue, and right pyriform sinus). The tracheal and base of tongue margins were reported as ‘negative for malignancy’, and the right pyriform sinus margin was reported as ‘squamous epithelium with highly atypical cells in the basal layers’ to the surgeon via telephone. The corresponding operative report indicated that all margins were reported as ‘clear’, and additionally, only listed the tracheal and right piriform sinus margins as submitted frozen section specimens. Tracheoesophageal puncture was carried out and the procedure concluded without any alterations in surgical management following intraoperative consultation. The right piriform sinus margin was positive for malignancy on permanent and additional sections. The patient presented with a recurrent right neck mass two months following laryngectomy and is currently undergoing additional treatment.

Case 2

The second major discrepancy similarly involved a margin status differing between positive and negative in the pathology report and operative note of a partial nephrectomy procedure in which the attending surgeon submitted the deep parenchymal margin for intraoperative evaluation. The frozen section pathologist reported the deep margin as ‘positive for malignancy’. The corresponding operative report read: “the deep margin had an area of normal parenchyma deep to the margin which I suspect relates to the depth of our resection and I believe grossly we have a negative margin in the patient”. The procedure was concluded with no changes in surgical management following intraoperative consultation.

Case 3

The third major discrepancy included diagnoses differing between benign and malignant, and confusing diagnoses among specimens during a large bowel resection. Upon exploration of
the abdominal cavity, four peritoneal nodules were identified by the surgeon and excised and submitted for intraoperative consultation as specimens A-D. The pathologist reported specimens A and C as “metastatic adenocarcinoma”, specimen B “negative for malignancy”, and specimen D as “mesothelial hyperplasia”. Below these diagnoses, the pathologist wrote “deferred” without indicating as to which – or all – specimens were included in this deferral. The corresponding operative report indicated “all specimens came back as being positive for adenocarcinoma” and did not acknowledge the deferral nor multipart diagnoses. As the nodules were previously excised, the procedure was concluded with no changes in surgical management following intraoperative consultation.

**DISCUSSION**

Major investigators and accreditation bodies acknowledge the significant impact intraoperative diagnoses may have on immediate surgical decisions, and as such, have thoroughly documented the reliability, precision, and accuracy of frozen section, as well as their possible sources of error. To date, an emphasis has been placed on preanalytical and analytical issues as the major sources of error at play during intraoperative consultation, with few studies investigating postanalytical factors like pathologist-surgeon communication. The sparse literature that does explicitly examine communication during intraoperative consultation suggests that postanalytical errors during intraoperative consultation occur as frequently as analytical faults, such as sampling error in some instances, although these may go unassessed and undetected in standard quality control review. In an effort to address this issue, this study indirectly examined the clarity of pathologists’ verbal communication with surgeons during intraoperative consultation, and the surgeons’ resulting interpretations of intraoperative diagnoses by evaluating the concordance of
intraoperative diagnoses recorded in intraoperative consultation pathology reports to surgeon-dictated operative notes.

Three major discrepancies were identified, accounting for 2% of evaluated cases. Ultimately only one case (case 1) resulted in unsuitable patient management at the time of surgery, after which the patient presented with a recurrent mass two months following the procedure. In this multipart case, two negative margins and one with ‘highly atypical cells’ were interpreted as all being definitively clear of malignancy. Additionally, the operative report made mention to only two of the three specimens submitted. Although it is apparent to a practiced pathologist that the presence of atypical cells may represent a positive margin on permanent section, terms indicating degree of certainty, such as ‘atypical’ may be interpreted very differently by a pathologist and a surgeon. Following the communication of a diagnosis, it is the responsibility of the pathologist to verify that the information was understood and received in the manner intended.

All major discrepancies occurred during multipart cases, which additionally highlights that multipart cases complicate the workflow of intraoperative consultations, increasing the chance of error during the communication of part-specific diagnoses. In some institutions, it is hospital policy that when multiple frozen sections are performed, each are to be mentioned separately by site in the corresponding operative note, which is not mandated locally.

The other two major discrepancies did not result in incorrect surgical management and otherwise would not have come to the attention of the pathologist, surgeon, or patient. In case 2, the surgeon appears to disagree with the frozen section diagnosis, which calls into question the clinical necessity of this intraoperative consultation. If there is no intent to modify the procedure, the frozen section should not be requested or, if requested, not performed. In case 3, both the
multipart nature of the case and the interpretation of the deferred diagnosis as conclusive (discussed below) contributed to the major discrepancy.

Minor discrepancies were noted in 35% of cases, a majority of which were multipart. This is higher than the two pre-existing studies examining communication as a source of error, reporting 9.3%\textsuperscript{32} and 2.7%\textsuperscript{31} of cases with minor inconsistencies without impact on clinical management. Many (42%) resulted from the operative report including additional information than the recorded intraoperative diagnosis, and an additional 18% resulted from surgeon interpretation of deferred diagnoses as definitive. This may be attributed to conversational, ‘off the record’ discussion between the pathologist and surgeon in the frozen section room or over the phone during intraoperative consultation. The pathologist may verbalize their thoughts while examining a specimen, ask the surgeon for additional information, or be further questioned by the surgeon following the intraoperative diagnosis.\textsuperscript{31} Although the communication in the above interactions should not be interpreted as part of the final intraoperative diagnosis, the results indicate this information may be regarded by the surgeon as more definite than the pathologist intended and more importantly, may be used to make treatment decisions. In fact, noteworthy differences have been well documented between what a pathologist intends to say versus what a surgeon hears.\textsuperscript{37} This highlights the importance of not providing more information than can be definitively determined by the tissue available for examination at the time of intraoperative consultation.\textsuperscript{32} This also reinforces the pathologist’s responsibility to thoroughly document any conversations that take place over the course of an intraoperative consultation, or explicitly state at the end of any discussion ‘my diagnosis is X’.\textsuperscript{35}

Cases in which the operative report included less information than the recorded intraoperative diagnosis accounted for 30% of minor discrepancies overall. This may be due to the
pathologist providing more information than clinically required at that time. Long and wordy reports are difficult to communicate verbally and run a higher risk of miscommunication and/or misunderstanding. Similarly, information such as the histological type or grade of the lesion in question is unnecessary and irrelevant to immediate surgical management, and if included, contributes to the risk of miscommunication. These results highlight the responsibility of the pathologist to clarify the intraoperative needs of the surgeon, aim for absolute succinctness, avoiding the use of abbreviations, eliminate superfluous information, and avoiding the use of terms indicating degree of certainty.

In 23% of cases, the frozen section diagnosis was not included in the surgeon’s operative report. This is higher than both previous studies examining communication as a source of error, which reported 8.3% and 20% respectively. This may be due to the surgeon completing the operative report in the days following a patient’s procedure and simply forgetting to include the request for or outcome of an intraoperative consultation, a surgical resident completing the operative report who was not directly involved with the intraoperative consultation, or the surgeon completing their report using a ‘mental template’ of the procedure in question which does not routinely involve an intraoperative frozen section. However, precise recording of the intraoperative diagnosis would be critical in the operative report and may also be important for medical legal purposes.

Additionally, it is obvious from the operative reports in a small subset of cases that the surgical procedure was concluded prior to receiving the intraoperative diagnosis. This, along with the absence of intraoperative consultation results in nearly a quarter of the examined cases brings the clinical necessity of these frozen sections into question. Considering known local costs, and extrapolating from existing literature and cost-analysis tools, it is estimated that locally, a simple
single-specimen intraoperative frozen section costs approximately $850 CAD, including pathologist and laboratory technologist labour, operating room and anaesthesia costs, technical equipment and support equipment costs, and consumable materials.\textsuperscript{42} Considering the current and continuing pressure to eliminate, or at the very least limit unnecessary healthcare costs, it may be worthwhile to review local policy regarding the obligatory content of operative reports and in the future recommend documentation for the reason an intraoperative consultation is required and its direct impact on surgical management. Currently, very little oversight is in place locally regarding surgeon’s use – and in rare cases, abuse – of intraoperative consultation.

Of the 25 deferrals encountered in this study, 56\% resulted in a minor discrepancy and 4\% resulted in a major discrepancy due to the surgeon failing to acknowledge the deferral and instead interpreting any information provided by the pathologist as a conclusive diagnosis. This accounted for significant proportion of minor (24\%) and major (33\%) discrepancies overall and therefore represents a significant source of miscommunication between pathologists and surgical personnel, which must be addressed from both perspectives.

For example, in one four-part case examined, the pathologist reported specimens A and C as metastatic adenocarcinoma, specimen B negative for malignancy, and specimen D as mesothelial hyperplasia, but included ‘deferred to permanent section’ at the end of the intraoperative consultation report without indicating which specimens this deferral applied to. As a result, the deferral was not acknowledged in the operative report and the surgeon appeared to interpret all specimens as being positive for malignancy. In another case, the pathologist transcribed “a small group of atypical cells adjacent to a vessel, ?granuloma [sic] Defer to permanent” which the surgeon interpreted as “no evidence of malignancy”.
In both cases, it can be argued that providing diagnostic information alongside a deferral nullifies the inconclusive nature of the term. On one hand, the pathologist is responsible for conveying in a straightforward manner that the specimen examined during intraoperative consultation cannot provide enough information to reach a diagnostic conclusion and is therefore deferred. It may be worthwhile to educate residents and new-in-practice pathologists that it may be more effective to simply communicate that the case is deferred without providing any further information, both on and off the record, that may be misinterpreted as a definitive diagnosis. On the other hand, it is also the responsibility of the surgeon to identify that a case is deferred and understand that any additional diagnostic information provided on a deferred specimen runs the risk of drastically changing on the final pathology report. Similarly, this may be an important educational point to make to new-to-practice surgeons as they establish their threshold for acting upon intraoperative consultations. An academic seminar with surgeons and pathologists including mock or archived intraoperative consultation scenarios may be a feasible way to address this gap in communication training.

Finally, specimen requisitions were evaluated for two quality assurance parameters. The intraoperative pathologist documented the reporting of the intraoperative diagnosis to the surgeon or OR personnel in 80% of reviewed cases. The specimen requisition was signed by the intraoperative pathologist in 93% of reviewed cases. Locally, these are well established quality management parameters, both of which are important features included in the postanalytical process of accurately documenting the result of the intraoperative consultation in the final pathology report. This data indicates an occasional lack of adherence to these parameters and calls into question the quality of communication occurring during these cases – which can only be evaluated if appropriately documented.
The definitive indicator of accurate intraoperative communication between pathologists and surgeons is correct patient management resulting from an intraoperative consultation. However, this data is challenging to gather and accurately interpret since each patient, their diagnosis, and their overall medical management is subject to a plethora of individual differences that may confound accurate comparison. It must be acknowledged that this study’s design – examining the concordance of intraoperative diagnoses recorded in intraoperative consultation pathology reports to surgeon-dictated operative notes – is an indirect assessment of surgeons’ interpretation of intraoperative diagnoses, and is therefore subject to some limitations, namely, using operative notes as an overall assessment of communication quality.

It is possible that in certain circumstances in which postanalytical errors were identified, operative notes were dictated – and thus interpreted – by surgical trainees and signed off by the attending surgeon who did not share this incorrect interpretation. Similarly, the quality of operative notes is dependant on the accuracy of the surgeon’s memory if they are dictated at a time distant from the procedure. Another possible confounding factor is communication breakdown beyond the control of the pathologist or surgeon, such as a poor connection, pronunciation, accent, multitasking, or an increased number of communication steps when information is passed through multiple individuals before being relayed to the surgeon. Finally, uncorrected typographical errors in either the final pathology report or the operative notes may have functioned as confounding factor in some cases.

The data collected and reported in this study follows trends similar to pre-existing literature that explicitly examines communication during intraoperative consultation and indicates that some verbally reported intraoperative diagnoses, especially deferred diagnoses, are misinterpreted by surgeons in Winnipeg hospitals. The incidence of a discrepancy did not result in clinical
mismanagement in most cases. However, the presence of these discrepancies, irrespective of their clinical impact, demonstrate that miscommunication can lead to inappropriate intraoperative management that has the potential to result in a patient requiring an additional surgery, receiving inappropriate treatment, or critically impacting their prognosis. Furthermore, this data suggests that postanalytical errors during intraoperative consultation may go undetected in standard quality control. This may necessitate changes in local quality management and education including rigorous audits on both surgical and pathologic records, multidisciplinary discussions and sessions to improve the communication tools to more effectively monitor intraoperative communication and errors.
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