Veterinary clinicians prefer template-style reports with personal confidence estimates for cytologic sample evaluations

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OBJECTIVE
To examine preferences of veterinary clinical pathologists, clinicians, and students for cytology report formats.

SAMPLE
24 clinical pathologists, 1,014 veterinarians, and 93 veterinary students who were members of the Veterinary Information Network.

METHODS
Members of the Veterinary Information Network responded to an online survey invitation, made available between July 11, 2023, and July 24, 2023. Respondents were randomly directed to 1 of 4 sets of cytology reports, each containing a traditional narrative format, narrative format with terms expressing a degree of confidence and associated numerical ranges, and template format with similar estimates of confidence. Respondents ranked the reports in order of preference and then provided comments about their top-ranked choice. Responses were analyzed mostly with descriptive statistics or comparisons of proportions.

RESULTS
14 of 24 clinical pathologists preferred the traditional narrative format, whereas 449 of 1,042 veterinary clinicians and veterinary students preferred the template format. Respondents (460/1,131) ranked the template format as most preferred, but the narrative format with terms expressing a degree of confidence ranked highest overall. Many respondents appeared to misunderstand the degree of confidence estimates being expressed numerically. Respondents choosing each format often stated that their preferred choice was “easiest to understand” and “most comprehensive.”

CLINICAL RELEVANCE
Given the preferences of veterinary clinicians and veterinary students for a template format, clinical pathologists should consider modifying the way they report evaluations of cytologic specimens. Template formats should help standardize reporting of cytologic specimens, thereby improving communication between clinical pathologists and clinicians. However, both clinicians and clinical pathologists need to better understand the purpose of terminology expressing degrees of confidence in such reports.

Keywords: uncertainty, cytology, reporting, terminology, cytopathology

All cytology reports aim to convey information from the clinical pathologist to the clinician or veterinary student accurately, succinctly, comprehensively, and without ambiguity.1,2 Clinical pathologists routinely generate reports about cytologic specimens, detailing their observations, thoughts, and conclusions to the submitting clinician. Currently, most reports are written in a free-form, narrative format and comprise 3 sections: a description of the cellular and noncellular observations made by the clinical pathologist, a summary interpretation of the findings, and a comment indicating useful information (such as prognostic information based on the interpretation, differential diagnoses if appropriate), additional testing that may help distinguish among the differential diagnoses, and/or testing to monitor disease progression and/or response to treatment.

We recently examined terms used by clinical pathologists in their reports of cytologic evaluations to express their degree of confidence or certainty about a diagnosis and the agreement about the meaning of these terms with clinicians who receive and read
the reports.\textsuperscript{3,4} We identified 7 nonoverlapping numerical ranges that could be represented by specific terms of confidence when providing an estimate of the degree of confidence of a specific interpretation. Eighty percent of clinicians and 85% of clinical pathologists strongly agreed that clinical pathologists should limit the number of terms used to describe such degrees of confidence in cytology reports. We then further refined terms corresponding to the numerical ranges on the basis of rankings by clinical pathologists. Restricting the number of terms conveying the pathologist’s confidence in the interpretation and their correspondence to specific numerical ranges, together with consistent, unwavering use of these terms, should result in better communication of the clinical pathologist’s interpretation and reduce the risk of medical errors by clinicians.

Report formats used by pathologists include a traditional narrative format, a synoptic format, and a structured template-based format. Pathologists have traditionally written reports using a narrative format, which consists of free-flowing prose in a few broad sections. However, studies have shown that such a report format can contain information within a paragraph that can be overlooked by a busy clinician and that pathologists might omit certain information that is prompted for in other formats.\textsuperscript{5–7} Synoptic formats mostly apply to surgical pathology reports and include a “data element” (a required field or variable) that is followed by a specific response (e.g., tumor size [data element]: 5.5 cm [response]), although radiologists have adopted similar formats for reporting cancer imaging studies.\textsuperscript{8,9} Data elements can be required or optional. Synoptic reports are specific for particular diseases (mostly various cancers) and require the pathologist to use the appropriate reporting form for each type of cancer being reported. A structured tabular template format provides specific fields for important information in an ordered (structured) way but can be used for all reports (the format is generalizable across diseases and pathologies).\textsuperscript{5,6,10} Such templates permit universal consistency in reporting so that clinicians do not need to learn the particular “styles” of the clinical pathologists to whom they submit cytologic specimens for evaluation.

The concept of structured reporting is not new: pathologists introduced initial proposals and template examples in the early 1990s.\textsuperscript{11–13} Pathologists and radiologists gradually adopted structured reporting, mostly as synoptic reporting, as computer software and databases permitted development and archiving of digital reporting forms.

A review of reporting formats supported the hypothesis that structured reports (both synoptic and nonsynoptic) improve clinical care (through better communication) and allow improved “secondary use” (i.e., research).\textsuperscript{10} Studies have found that pathologists provide more complete reports with clinically useful information with synoptic reporting for cancers and that clinicians prefer synoptic cancer pathology reports.\textsuperscript{14,15} A study\textsuperscript{16} found that synoptic reports for placental pathology included more information than narrative reports and displayed better inter-reader agreement than narrative reports. Similarly, radiologists completed structured reports faster than narrative reports and both radiologists and clinicians reading the reports preferred the structured format.\textsuperscript{17} Finally, structured reports can be created using databasing software, allowing indexing, archiving, and retrieval of reports, as well as collecting reports through national or international databases.\textsuperscript{18} Few, if any, studies have examined template format reports that are not synoptic.\textsuperscript{19} Indeed, most of the recent articles examining structured reporting in cytopathology focus on standardized terminology rather than standardized formatting and fields requiring reporting.\textsuperscript{20–22}

Despite the apparent benefits of structured reporting, few, if any, veterinary clinical pathologists currently use template formats for reporting. Some organizations with clinical pathology services have expressed interest in standardizing the reporting of cytopathologic specimens (Dr. N. Balogh, PraxisLabs, Budapest; Dr. S. Medic, Veterinary Laboratory, Belgrade; verbal communications, Sept 01, 2023). However, whether veterinary clinicians prefer a template or narrative format remained unknown prior to this study.

Therefore, we conducted a survey to examine report format preferences of veterinary clinicians and clinical pathologists. We hypothesized that clinicians would prefer a template format that includes confidence range estimates.

**Methods**

We created a survey using an online survey platform and distributed it to members of the Veterinary Information Network (https://www.vin.com).\textsuperscript{21} The survey contained 4 cytologic reports, each presented in 3 formats: (A) a traditional narrative format, (B) a narrative format but with confidence range estimates and specific terms expressing the degree of confidence, and (C) a template format with confidence range estimates and specific terms expressing the degree of confidence (Supplementary Material S1). The 4 cases in the reports were as follows: (1) a fine-needle aspirate of a small tumor-like mass over the left muzzle of a dog (round cell tumor), (2) bronchoalveolar lavage of a gelding with a chronic cough (mucopurulent inflammation), (3) a pleural fluid specimen from an older dog with dyspnea (suspected mesothelioma), and (4) a fine-needle aspirate of a suspected recurrent mast cell tumor (inconclusive). All 3 formats contained identical textual information (with the exception of the numerical confidence range estimates and the terms associated with these ranges), which were adopted from our previous studies.\textsuperscript{5,14} Participants were randomly directed to viewing and responding about the 3 formats for only 1 of the 4 reports, by means of a randomization function within the survey. Once they had viewed the 3 report formats, they were asked to rank the formats in order of preference; if they had no preference, they could choose that option instead. Finally, all respondents who ranked the formats were asked to provide a comment about why
they preferred a specific format and any additional comments about reporting formats in general.

We determined descriptive statistics regarding the results of the survey. First, we examined overall rankings of each format. We compared which format garnered the greatest number of “first-choice” votes—the format that ranked first most often was the most preferred format. We then compared the weighted ranks for each format, as calculated by the survey platform: the first choice scored 3 points, second choice scored 2 points, and third choice scored 1 point. The cumulative score for each format was calculated, and the format with the highest cumulative score was the weighted preferred format. We then stratified the rankings by self-reported professional qualifications (clinical pathologist, other specialist, nonclinical veterinarian without additional specialty training, resident or intern, clinical veterinarian without additional specialty training, or student). To determine whether graduation year of the respondent correlated with their preferred format, we compared the graduation years of respondents choosing each of the 3 formats as “preferred” using a Kruskal-Wallis test with a Dunn post hoc comparison.

We also examined whether any particular report (of the 4 to which respondents were randomly directed) was more likely to garner a preferred format different from the other reports by χ² tests and evaluation of the deviations of residuals. Finally, we examined the comments about preferences.

Results

We obtained 1,131 valid, analyzable responses: 842 (74%) from clinicians without specialty qualifications, 118 (10%) from specialist clinicians, 93 (8%) from veterinary students, 30 (3%) from nonclinical veterinarians without specialty qualifications, 24 (2%) from clinical pathologists, and 24 (2%) from veterinarians undergoing specialty training. Two hundred sixty-five (24%) respondents examined the first report, 297 (26%) examined the second report, 285 (25%) examined the third report, and 284 (25%) examined the fourth report. Fifty-nine (5%) respondents ranked only 1 format, while 41 (4%) respondents expressed no preference for any of the formats; therefore, 1,031 (91%) respondents ranked all 3 formats in order of preference. We included all valid responses in the various analyses of preference; for example, for the most popular “preferred” format (first-ranked choice), we included the 41 respondents who only ranked 1 format, whereas for the “weighted preferred” format, we excluded these respondents.

A slightly higher proportion of respondents who viewed report example No. 2 ranked the traditional narrative format as most preferred than respondents who viewed other report examples (29% vs 16% to 21%); however, the highest proportion of respondents ranked the template format as most preferred, regardless of which report example they viewed (41% template format vs 34% narrative format with confidence ranges vs 22% traditional narrative format, Table 1).

Regarding the most preferred report format, the template format with terms and numerical estimates expressing degree of confidence garnered the most responses (Table 2). Similarly, the traditional narrative format was ranked third most frequently. Using the weighted rank scoring system (provided by the survey platform), the narrative format with terms and numerical estimates expressing the degree of confidence ranked highest (Figure 1).

When examined by professional qualifications, clinical pathologists appeared to prefer the traditional narrative format more than any other; residents preferred the narrative format with terms and numerical estimates expressing the degree of confidence (Table 3). In contrast, all other respondents preferred the template format with terms and numerical estimates expressing the degree of confidence more than any other and preferred the traditional narrative format least frequently. Veterinary students ranked the template format first almost 3 times as often as the narrative format with terms expressing degrees of confidence and associated numerical ranges 5 times as often as the traditional

<table>
<thead>
<tr>
<th>Table 1—First-choice ranking (%) of report formats for each of the 4 example reports.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Report</strong></td>
</tr>
<tr>
<td>Report 1</td>
</tr>
<tr>
<td>Report 2</td>
</tr>
<tr>
<td>Report 3</td>
</tr>
<tr>
<td>Report 4</td>
</tr>
</tbody>
</table>

Values in bold are different from other values in the same column (P < .05).

<table>
<thead>
<tr>
<th>Table 2—Ranks of each report format.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>First choice</strong></td>
</tr>
<tr>
<td><strong>Traditional narrative format</strong></td>
</tr>
<tr>
<td><strong>Confidence-based narrative format</strong></td>
</tr>
<tr>
<td><strong>Confidence-based template format</strong></td>
</tr>
<tr>
<td><strong>No preference</strong></td>
</tr>
</tbody>
</table>

Values in bold highlight the highest count in each row.
narrative format. We found no association between the age of the clinician and their preferred reporting format ($P = .8$).

We then examined whether respondents selecting either the traditional narrative format or the template format considered the narrative format with terms and numerical estimates expressing the degree of confidence a compromise for their first-ranked options but better than the other alternative. We found that relatively few respondents who selected either the traditional narrative format or the template format ranked the alternative “extreme” format as their second choice, while almost twice as frequently, these respondents ranked the narrative format with terms and numerical estimates expressing the degree of confidence second (Table 4).

When we examined the comments regarding the first-ranked choices of respondents, some common themes emerged. Approximately 16% of respondents choosing the narrative formats stated that they did so because of “familiarity” with that format (30% of the traditional narrative and 7% of the narrative format with terms and numerical estimates expressing the degree of confidence). Approximately half of the respondents who ranked the narrative formats first commented that they did so because it was the “easiest to read or comprehend”; however, 80% of those choosing the template format commented that they

### Table 3—First-ranked format choices by professional qualifications.

<table>
<thead>
<tr>
<th>Item</th>
<th>Overall Rank</th>
<th>Rank Distribution</th>
<th>Score</th>
<th>No. of Rankings</th>
</tr>
</thead>
<tbody>
<tr>
<td>(B) Confidence-based Narrative Format</td>
<td>1</td>
<td>![Confidence-based Narrative Format]</td>
<td>2,302</td>
<td>1,053</td>
</tr>
<tr>
<td>(C) Confidence-based Template Format</td>
<td>2</td>
<td>![Confidence-based Template Format]</td>
<td>2,209</td>
<td>1,067</td>
</tr>
<tr>
<td>(A) Traditional Narrative Format</td>
<td>3</td>
<td>![Traditional Narrative Format]</td>
<td>1,891</td>
<td>1,053</td>
</tr>
<tr>
<td>I have no preference for any of the reports</td>
<td>4</td>
<td>![I have no preference]</td>
<td>141</td>
<td>50</td>
</tr>
</tbody>
</table>

### Table 4—First- and second-choice rankings.

<table>
<thead>
<tr>
<th>First choice</th>
<th>Traditional narrative</th>
<th>Confidence-based narrative</th>
<th>Confidence-based template</th>
</tr>
</thead>
<tbody>
<tr>
<td>Second choice</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traditional narrative</td>
<td>—</td>
<td>239</td>
<td>97</td>
</tr>
<tr>
<td>Confidence-based narrative</td>
<td>146</td>
<td>—</td>
<td>331</td>
</tr>
<tr>
<td>Confidence-based template</td>
<td>90</td>
<td>128</td>
<td>—</td>
</tr>
</tbody>
</table>

Figure 1—Rank distributions for each report format, with overall rank, total score, and number of rankings. The narrative format with confidence-based terms (B) ranked highest overall, although the template format with confidence-based terms (C) had a higher number of first-ranked responses (dark blue bar) than either the traditional narrative report (A) or the narrative report with confidence-based terms (B).
did so because that format was the “easiest to read or comprehend.” Approximately 5% of respondents commented that the narrative format was more comprehensive or contained more information; some 10% of those choosing the template format felt that this format was more comprehensive or contained more information. Approximately half of the respondents who chose formats containing terms and numerical estimates expressing the degree of confidence commented that they liked a confidence estimate to be provided because they could convey this information to clients (70% of those who chose the narrative format with terms and numerical estimates expressing the degree of confidence and 36% of those who chose the template format).

Discussion

Our study demonstrates that veterinary clinicians (specialist and nonspecialist) and veterinary students prefer cytology reports that have a template format and provide estimates of the degree of confidence that a clinical pathologist has in an interpretation based on their assessment of the samples. Conversely, over half (58%) of clinical pathologists prefer traditional narrative reporting formats that omit such estimates of the degree of confidence, and an additional 17% prefer narrative reports that include estimates of the degree of confidence, resulting in 75% of clinical pathologists preferring a narrative format. Our study highlights a disconnect between clinical pathologists (the report writers) and clinicians or students (the report readers) and suggests that clinical pathologists should reexamine their reporting methods to better meet the preferences of their clients, the clinicians who read and act on the reports provided by clinical pathologists.

Clinicians and students preferred reports that contained what we called “probability estimates” (regardless of whether they were narrative or template formats). Clinical pathologists, however, preferred to omit providing such numerical estimates in their reports. When explaining their choices, clinical pathologists struggled with numerical estimates, incorrectly believing that these are based on objective reality rather than estimates of their personal confidence in a diagnosis or finding. This might be in part because the term “probability” connotes objectivity or that the numerical estimate is based on hard evidence, even though “subjective probability” is a valid statistical concept (most commonly applied in Bayesian statistics). Instead, as we have tried to explain in our previous studies, these estimates are subjective “beliefs” about the likelihood of a diagnosis based on the available information (cytologic specimen quality, cells observed, clinical history, signalment, and the pathologist’s experience, clinical confidence, and even mood at the time of reporting). Consequently, the numerical estimates provided by 2 clinical pathologists examining the same specimen could vary (hopefully by only 1 level for most cases) because of their personal confidence with a specific differential diagnosis. Therefore, in the current manuscript we have changed “probability-modifying terms” and “probability estimates” to “terms and numerical estimates expressing the degree of confidence.” Such a semantic change will hopefully dispel the idea that the term and number denote some sort of objectivity. Nevertheless, the reality is that clinical pathologists will have to accept that this survey shows that clinicians prefer numerical estimates of confidence that help them determine their next course of action with a patient. Clinical pathologists routinely use a large variety of vaguely defined terms to denote their confidence and thoughts about the cytologic specimen; standardizing these terms and including a range of numerical estimates to these terms only helps clinicians better understand the clinical pathologist’s intent.

Many clinicians also tended to misinterpret the term “probability estimate,” on the basis of the comments they provided. They frequently commented that clients ask for probabilities of a particular diagnosis and that the reports containing these estimates allowed them to convey this information to the clients numerically. However, this could be problematic because the probability estimate is subjective, essentially representing “how likely the pathologist thinks a specific diagnosis is,” rather than being an absolute truth. Such expressions of confidence (ie, subjective probability or uncertainty) depend on the factors listed above rather than objective data. Indeed, providing objective probability estimates would be impossible because of the factors involved. Therefore, clinicians should not believe that these estimates are objective “statements of fact” but rather impressions and “best guesses” of fallible pathologists. To avoid confusion with semantics related to the term “probability,” we have adopted the phrase “terms and numerical estimates expressing the degree of confidence.” This phrase might more easily convey the fact that these reflect subjective assessments by individual clinical pathologists and may or may not reflect the true probability of a specific diagnosis. It is possible to be highly confident in an interpretation but come to the wrong conclusion or be of low confidence and still provide the correct interpretation. Because of the training clinical pathologists receive to become specialists, we come to expect a high degree of confidence to reflect a high level of diagnostic accuracy, and rightly so. However, the “degree of confidence” is meant to convey the feelings of the individual clinical pathologist. Less experienced pathologists, for example, or ones who are not experts in a particular site or species are expected to have lower “degree of confidence level” estimates than experienced pathologists with expertise associated with a particular type of cytologic collection and/or species.

We previously provided the analogy of threat assessment by intelligence analysts, who provide estimates of probability of a threat based on incomplete data and personal experience (as well as other biases). Clinicians and clinical pathologists should approach cytologic estimates of their degree of confidence in a similar fashion; that is, the estimate is a clinical pathologist’s personal judgment, taking
various factors into consideration, about the contents of the cytologic specimen and not a “matter of fact” statement. Clinicians often ask clinical pathologists, “how likely do you think this is disease X?” to which the clinical pathologist might respond, “I think there’s a high probability that it is (or is not) disease X.” The reports providing standardized terms and a glossary of probability ranges simply take the clinical pathologist’s “high probability” or “low probability” estimates and place them in the report.

All 3 report formats contained identical contextual information. Nevertheless, a small percentage of respondents believed that the format they chose provided the most comprehensive information. Clearly, this was an incorrect assertion by respondents. Unsurprisingly, those clinicians who preferred the narrative formats often stated that they based their choice on familiarity: “what I am used to” (Supplementary Material S2). Although change of any type is difficult, we could reasonably assume that clinicians would soon adapt to a template format if routinely provided with one. Importantly, 61% of students, who comprise the future veterinary clinical readers of cytology reports, preferred the template format. Students are least likely to be biased by past experience of reading cytology reports and therefore most likely to provide an unbiased opinion. Again, clinical pathologists should note that they are generating reports for their clients and client preferences should supersede tradition.

Half of respondents choosing the narrative formats felt that their first-ranked choice was the “easiest to read” or “simplest” or “provided information I can find most quickly.” However, 80% of respondents choosing the template format reported that this format was easiest to read and, because it contained discrete fields, would reduce omissions of information (assuming that each field was filled in by the clinical pathologist).

The narrative format with terms and numerical estimates of the degree of confidence was ranked highest overall (using a rank-weighted approach). However, we believe this is because it was the “fall-back” option for those choosing either the traditional narrative or template formats—those who ranked either of these 2 formats as first-choice infrequently ranked the other as second-choice. Instead, both groups compromised with their “next-worst” choice. However, when viewing the most frequently first-choice-ranked option, the template format was most popular with all respondents except clinical pathologists.

We were surprised that, among clinicians, preferences for formats were unassociated with graduation year. We thought that longer-graduated clinicians would prefer the narrative format, because “that’s what they’re used to,” whereas more recently graduated clinicians would be more amenable to change. However, this did not appear to be the case, with similar distributions of graduation years for each of the 3 formats.

We cannot explain why clinicians who were directed to sample report 2 more frequently preferred the traditional narrative option than those who were directed to the other sample reports. Two reports detailed neoplasia, 1 report (No. 2) detailed equine pneumonia, and 1 report was inconclusive. Respondents of all qualifications responded in similar proportions to each of the 4 reports, so we could not detect a chance bias of clinical pathologists or specialists (who most often preferred the traditional narrative format) responding to report No. 2. Consequently, we can only attribute this observation to chance. Despite this observation, a substantially higher proportion of respondents to report No. 2 chose the template format than the narrative formats.

We did not survey clinical pathologists directly. The responses from clinical pathologists that we garnered were from those who are Veterinary Information Network members and opted to take the survey. Therefore, the sample population of clinical pathologists was rather small. However, based on our previous surveys of clinical pathologists, we believe the views expressed by the respondents in this study largely mirror those of the clinical pathology community.

We provided only 1 template format, based on the experience of one of the authors. Whether other templates with additional information or fields would prove better remains unknown.

Clinicians and veterinary students prefer a template format that contains subjective estimates of the pathologist’s degree of confidence expressed as terms and numerical range estimates for cytology reports that clinical pathologists routinely provide. Such a format standardizes the reporting across clinical pathologists, allowing clearer and hopefully better communication between clinicians and clinical pathologists. However, clinicians and clinical pathologists should understand what the confidence estimates represent (a subjective assessment of confidence by the clinical pathologist) and use them appropriately when making clinical decisions or explaining the reports to clients. Such clarity would hopefully translate into better patient care. Clinical pathologists in catering to their clients—the clinicians—should strongly consider modifying their reporting approaches to better serve clinicians and patients alike.

Acknowledgments

None reported.

Disclosures

The authors have nothing to disclose. No AI-assisted technologies were used in the generation of this manuscript.

Funding

The authors have nothing to disclose.

References


Supplementary Materials

Supplementary materials are posted online at the journal website: avmajournals.avma.org