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Multilingual and Native English-speaking Student Writers in Medical Laboratory Sciences (MLS): A Comparative Pilot Study

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Abstract: Medical laboratory scientists are health care practitioners who perform testing on blood and other body fluids providing vital information to physicians for the diagnosis, treatment, and management of patients in health and disease. Miscommunications between laboratory personnel and other health care practitioners can result in unwarranted delays in patient care or errors in treatment selection, which ultimately could cause patient harm, including the possible loss of life. In spite of prerequisite writing course requirements, students in our laboratory science baccalaureate degree program struggled to reach the program's writing competencies. The situation in our program was complicated by the high percentage of multilingual students with varying abilities in English. This pilot study was initiated to describe the nature of writing in our field of practice and to analyze the current status of student writing abilities. A survey of writing activities among current laboratory science practitioners confirmed the essential nature of writing in our field and the types of writing activities performed on a regular basis. Analysis of current student writing samples showed that both native-English speaking and multilingual student writers made essentially the same types of errors although the multilingual students made significantly more errors in some categories.

Keywords: medical laboratory science, undergraduate, writing abilities, multilingual students, writing errors

Background/Introduction

Clinical or medical laboratory science (MLS) practitioners are the third largest medical workforce, immediately following nurses and physicians (Bureau of Labor and Statistics, 2014). MLS practitioners perform testing on blood and other body fluid samples sent to the "lab" for

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analysis. Because laboratory testing results account for approximately 70% of any patient's health care record, MLS practitioners are pivotal members of the health care team (Forsman, 2000). For that reason, MLS practitioners must be able to address a variety of audiences in both written and oral language in a clear, accurate, and often very concise manner. The ability to clearly communicate patient test results and testing options is a critical issue to ensure the efficiency and quality of patient care. For the entry-level practitioner, this communication will most often be with other healthcare professionals regarding laboratory testing that has been requested or performed; however, they may also be asked to explain specimen collection or laboratory results to patients and their families. The graduates of our particular program often move quickly into lead, supervisory, or managerial roles, so the educational program must also prepare them to communicate effectively with laboratory and hospital administrators as well as regulatory and accrediting agencies throughout their career progression (Conway-Klaassen, 2013).

Our medical laboratory science baccalaureate degree program's typical class cohort is 60-70 students, many of whom enter the curriculum only for the senior year of the undergraduate degree program: the professional year. Clinical preceptors, individuals who mentor our students during their clinical practicum experience and Program faculty have been frustrated with the writing abilities of students in spite of the University's requirement for writing intensive course instruction in each academic year of their degree plan. Students may come to our program with some basic writing skills, but they often do not know how to apply these skills to writing in a highly technical science-based healthcare field that requires a high level of accountability. Having students only for the final year of their degree plan creates a significant challenge when

we are faced with the need to bring them to writing communication competencies, while also achieving the required outcomes of our accredited program.

Two additional factors are somewhat unique for our particular student cohort. First, a high percentage of our students transfer to our program from outside the University (52-56%) further expanding the range of skills students bring into the program. Second, our student population is one of the most culturally diverse undergraduate programs at this University, with a typical average of 45-50% non-native English speaking students, who are also primarily transfer students (MLS Program, 2013). There is a wide range in these students' abilities to communicate in English, both in written and oral form. Reading and writing in a medical and technology-based curriculum is even more difficult for the multilingual student who is often still developing their basic English skills and who must now add medical terminology and field-specific technical terminology to their vocabulary (Brown, 2007). Bosher (2010) has identified language as "the most significant barrier faced by the majority of English Second Language nursing students" (p. 352). Weaver & Jackson (2011) acknowledged the difficulty non-native English speaking nursing students face learning the conventions of writing in their discipline, compounded by the difficulty of writing in a second language. Leki (2007) noted how professors of nursing in her study struggled with the evaluation of academic English, given the importance of accuracy in the field. Considering the time constraints of the nursing program and the requirements necessary for accreditation, "…nursing faculty wanted their students to write without errors in standard academic style but felt that teaching such skills was the job of the English department and hoped students came into nursing already equipped" (p. 96). These thoughts concerning the need for accuracy and faculty expectations of students' language skills coming into the program have also been expressed by faculty in medical laboratory science programs. Bosher (2010) observed that

in response to these concerns, some nursing programs considered raising cutoff scores on the TOEFL or other language admission tests, but that these measures seem counter-productive if a program goal is "to increase diversity in the profession of nursing" (p. 348).

Students' abilities to speak, read, and capably understand English in the classroom are key to their success in the academic program, as well as in the profession. However, many of our multilingual students converse in English only while in the classroom setting, which limits their practice time toward competency (Conway-Klaassen, 2013). Although assessing the ability to read, understand, write, and follow directions in English is part of the program's admissions process, problems with students' English proficiency may not be revealed until they are challenged during course assignments, and the lack of proficiency may, in turn, hinder their ability to be successful in the academic program and therefore on the job. Many of our students do not understand the extent to which effective writing skills will be important for their daily practice and for their long-term professional development.

Current literature on student writing shows that writing activities can improve students' abilities to critically evaluate and reason as well as improve learning outcomes related to the content material (DeFazio, 2010; Kennison, 2006 & 2012). A number of strategies have been used to improve student writing skills, including the use of peer-reviewers to guide writing skill development (Hartberg 2008; Gunersel 2008) and "writing to learn" (Dlugokienski, 2008; Schmidt, 2004). Studies of student perspectives on writing in the disciplines showed that students might benefit from learning the value of writing in the discipline through direct discussions with faculty and practitioners and exposure to discipline-specific examples (Goldschmidt, 2014; Russell, 2001). Bosher (2001) emphasized the need for clarity in assignments and feedback: "Discipline-specific literacy is more easily acquired, especially for

second language students, when expectations and the extent to which a student has fulfilled those expectations are made as explicit as possible" (34). Another important consideration is the need for "ongoing, regular support" to develop academic writing skills in a profession (Weaver & Jackson, 2011, p. 137) which should include not only positive interactions between students and faculty (Leki, 2007) but collaboration between medical faculty and ESL faculty in an institution (Bosher, 2010).

The MLS Program faculty realized they had made some incorrect assumptions about students' writing abilities and readiness to adapt their writing to our discipline's needs. It was with these issues in mind that Program faculty became interested in developing and implementing an intentional approach to developing focused writing instruction by engaging with the Writing-Enriched Curriculum (WEC) Program at our University.

The Writing-Enriched Curriculum Program was initiated at our university in 2007, through support from the Bush Foundation, as a way of strategically incorporating writing development into undergraduate curricula (WEC, 2014). The WEC program is now supported through the Office of Undergraduate Education. Each year five disciplines are accepted into the program so that eventually all undergraduate units will be engaged. The Campus Writing Board approved the MLS Program's application in 2013.

Research Questions for this Pilot Study

Faculty in the MLS program worked closely with the WEC Faculty Liaison to create a writing plan specific for our field of study (Spannaus-Martin, 2013). As we began this project, we needed to first identify what writing activities were common in our profession, as well as determine the essential writing skills and abilities used in the workplace. However, a review of the literature did not reveal any specific studies about MLS practice and writing. We also

needed to understand exactly what writing skills our students brought to our program so that eventually we could develop an instructional platform for writing in our courses. We began with a series of surveys designed by the WEC Program to gather background information and a pilot study analysis of current student writing samples to examine these questions.

Research Question 1: What are the essential writing skills and abilities utilized by successful MLS practitioners?

Research Question 2: What are the writing skills and abilities of students currently enrolled in the MLS Program?

Research Question 3: Are there similarities and differences in writing abilities when comparing native-English speaking and multilingual students in the MLS program?

Research Method

Participants and Survey

To help describe writing activities in the laboratory profession ten full-time MLS faculty and 141 clinical partners were asked to participate in our survey. In addition, 163 current MLS students at various stages of the degree program (juniors, seniors, and clinical students) were asked to participate in the study. A separate survey was developed for each of the target audiences with parallel questions related to their perspective. Each of the MLS discipline specific surveys was derived from the WEC Program (WEC Surveys, 2007). The survey for the clinical practitioners asked them to describe the types of writing activities they performed in their work position, the importance of writing to fulfilling their work duties, their expectations for new graduates' writing abilities, and their satisfaction with recent graduates' writing abilities. The faculty survey asked about their experiences with teaching and grading writing assignments, as

well as the types of writing activities assigned in their classes. The survey also asked program faculty to rate the importance of writing skills for the laboratory field, what they perceived as its importance for graduates, and their satisfaction with students' writing abilities.

The student survey asked their perceptions, valuing, and understanding of writing needs in the laboratory professional courses and what they thought would be required of them in the workplace. The student survey also asked additional demographic and student status questions not readily available from university databases such as their first language and transfer enrollment status. Students were then asked to rate the quality of their personal writing abilities and what instructional resources they had used on campus. All surveys were administered and results were collected by the WEC liaison assigned to our program.

Reviewers of Student Writing

Three multilingual writing specialists (MWSp) were contracted by the MLS program, through the University WEC program, to work on this project. Each of these individuals had a strong background in teaching and evaluating writing of multilingual students in post-secondary education. An initial meeting was held to describe the writing needs of the laboratory profession to the writing specialists as well as the specific needs of the academic program. After this discussion, the MWSp were asked to read, analyze, and characterize (code) each individual sample for global (understanding) and local (sentence-level) errors. The Global (non-sentence-level) error codes were derived from Case Study Abstract instructions, and from the MLS Writing Plan's list of discipline-specific writing characteristics and abilities (Spannaus-Martin, 2013). Local (sentence-level) error codes were published originally in Ferris et.al. 2013. Three local error codes were added to the list during artifact analysis to address punctuation errors (other than apostrophe errors), missing words, and capitalization errors. A pilot study coordinator

was assigned to the project from the WEC Program to help facilitate the interaction between MWSp and MLS faculty.

Writing Samples

As one of their assignments for a senior year research methods course, students were asked to develop an abstract from materials presented in a case study. A similar assignment was required during their clinical (final) semester as part of their laboratory management course. Because these abstract assignments included a significant amount of technical terminology, a third, less technical, writing assignment was also selected for evaluation by the MWSp. This 500-word reflective essay assignment asked the students to describe their experiences in the medical laboratory after completion of their first week of clinical practicum in the hospital setting. Since the vast majority of students have never experienced this environment, we have found this a useful assignment for helping students to reflect on and evaluate their role on the health care team. Fifty-four of these writing samples were from 27 native speakers of English (NES) students (45 abstracts; 9 reflections), while 56 writing samples were from 30 multilingual speakers (ML) students (49 abstracts; 7 reflections). All writing samples were de-identified before review.

Results

Participants

Students. Sixty-seven of the 163 students (41% response rate) currently enrolled in the program (juniors, seniors, and clinical) responded to the background information and writing perception survey. Thirty-six students (54%) had transferred into the university to enter the MLS program, including one student with a previous baccalaureate degree. Of the senior

students who responded to the survey, 57 (34 females/23 males) agreed to have their writing samples evaluated for this study. Thirty student writers (53%) were multilingual (ML) speakers representing an array of 12 different primary language backgrounds including Akan (1), Amharic (7), Arabic (2), Cambodian (4), Cantonese (1), Chinese (2), Kiisi/Swahili (1), Korean (2), Oromo (2), Russian (3), Somali (3), and Vietnamese (6). Some students spoke a combination of languages at home, for example, Amharic and Oromo or Somali and Oromo. Twenty-seven (47%) of the student participants were native speakers of English (NES).

Faculty and MLS Practitioners. All ten full-time program faculty participated in the study including one full professor, three assistant professors and six instructors. All had been in the laboratory field for at least 10 years with 1-27 years teaching experience. Forty-seven clinical affiliate practitioners (33% response rate) who participated in the study were in lead technologist, technical supervisor, supervisory, or director/managerial positions, including one Chief Operating Officer.

Writing Expectations Survey

Ninety percent of the program faculty and 94% of clinical affiliate practitioner respondents rated writing skills and abilities as extremely or very important in the laboratory field, compared with only 72% of the student respondents (Table 1). Students seemed to consider MLS a highly technical science field involving considerable work with computers and instrumentation and that writing was not an important part of the job or career activities. When asked to rate their writing abilities in a variety of genres, one third of the students rated their own writing ability as strong, while 45% rated their writing as satisfactory. Only 12% of the students rated their writing ability as weak or did not know, while 10% rated writing ability as "NA" or not applicable. Only one of the program faculty rated student writing abilities as strong, two

faculty rated student writing as satisfactory, and four faculty rated student writing as weak. Three program faculty were unable to rate student writing because they're not directly involved in evaluating student writing projects.

Table 1

Importance of Writing Skills and Abilities by Participant Group

Writing Importance	**Program Faculty (n=10)**	**Clinical Affiliates (n=47)**	**Students (n=67)**
Extremely Important	50%	64%	21%
Very Important	40%	30%	51%
Somewhat Important	10%	6%	24%
Not important	0	0	~2%
Not at all Important	0	0	~2%
Unsure	0	0	~2%

Affiliated laboratory practitioners stated that between 40 and 80% of their job involved writing activities, primarily correspondence, presentations, and various reports (Table 2). The common characteristics of their writing included explanatory (89%), analytical (91%), concise (89%), and descriptive (96%), which they also rated as the more important characteristics of their writing. Program faculty rated these same characteristics as the most common and most important for laboratory practice writing. Laboratory practitioners rated technical aspects of writing (spelling, grammar, punctuation, etc.) as the most important characteristic of writing they expected of new employees (74%), followed by the use of specific terminology (55%), and the ability to create concise descriptions (38%). When asked about their satisfaction with the quality of writing for new employees, the majority of survey respondents rated their writing as Neutral (32%) with only 23% rating new employee/graduate writing as Satisfactory and 4% Dissatisfied. Because of the nature of their job positions, seventeen practitioners (41%) stated they did not know, or had no direct experience with new employee writing. The writing issues in our program

are not limited to our multilingual students, but seem to pervade the student cohort. Comments from laboratory practitioners highlighted the need to improve communication skills of all new graduates, not just multilingual graduates, from basic spelling and grammar to writing for different audiences to convey the correct information. A sampling of clinical practitioner comments is shown below.

> *New graduates come into our field without the necessary writing skills to perform simple tasks. If they didn't have spellcheck, they may not survive! Texting verbiage has taken over good grammar and spelling technique that is essential for almost every job skill.*
>
> *The writing ability of most students that become new hires is lacking. Spelling and grammar is poor. This is not limited to hires where English is not their primary language.*

Table 2

Frequency of Writing Activities for Current Laboratory Practitioners

Writing Type	**Selected (n=47)**	**Percent**
Correspondence	45	96
Reports	45	96
Presentations	40	85
Budgets	34	72
Medical Records	30	64
Proposals	29	62
Sketches, graphics, technical drawings	13	28
Other Writing:	15	32
Procedures	9	19
Performance Reviews	3	6
Policies	3	6
Communications and procedures	1	2
Mathematical calculations	1	2
Abstracts	1	2
Presentations and objectives	1	2
Method validations	1	2

Evaluation of Writing Samples

A total of 110 MLS student writing samples were reviewed by the multilingual writing specialists. Fifty-four of these writing samples were from 27 NES students, while 56 writing samples were from 30 ML students. These student ratios are consistent with the typical MLS program cohort demographic. Each multilingual writing specialist analyzed approximately one-third of the total sample set. Because data for only seven of the 21 error types followed a normal distribution and because the error counts in some categories were small, the Mann-Whitney *U,* non-parametric equivalent to a *t* test for independent samples, was used to compare the error frequencies between native-English and multilingual student writers.

Case Study Abstract Evaluation. The MWSp reviewed the 94 abstract writing samples for both global errors, e.g. those that interfere with the ability to understand the meaning of the written passage or not following instructions, as well as local errors, those found within a sentence such as spelling, grammar, and punctuation. The MWSp identified 23 global-level errors in the 45 NES abstract writing samples, with about 50% of the errors resulting from students missing required components of the abstract assignment (incomplete abstract) (Table 3). They also identified 32 global-level errors in the 49 ML abstract writing samples, with both incomplete abstract and missing case study author information accounting for 44% of the errors. Among global errors, the only significant difference between the student groups was within the Introduction portion of the abstract, where five of the 30 ML writing samples contained either unclear or confusing information, but none of these errors were found in the NES writing samples (U=990, z=-2.190, p=.028, r=-0.23). The overall difference in detected global errors was not significant.

Abstracts written by NES students contained an average of 2.58 sentence-level or local errors per writing sample compared to 8.73 errors per writing sample for ML students (Table 3). The most frequent sentence-level errors for NES students included article errors (usage of "a," "an," and "the"), comma usage, and consistency of verb tense usage (e.g. shifting between past to present tense). Multilingual student writers also made frequent errors with articles and consistency of verb tenses, but additionally had difficulty with pluralization of words, as well as using the wrong word or the wrong form of a word. In spite of the high number of errors present, the MWSp labeled only four of the 94 abstract writing samples (4.3%) as containing errors sufficient to impair the reader's comprehension of the essay.

Statistically significant differences were found in the frequency between the student groups for 11 of the 21 local error categories. For example, even though students in both language groups made the highest number of errors in the article usage category, multilingual students made significantly more errors resulting in a Cohen's medium effect size (U=596.5, z=-4.152, p=.000, r=-.428). Other significant differences with medium effect size were found for pluralization errors, consistency of verb tense, and word forms (Table 4). When comparing the total numbers of local errors, a large effect size was seen with ML students committing more than three times the number of errors as NES students per writing sample (U=246.5, z=-6.504, p=.000, r=-.671).

Table 3
Abstract Assignment Writing Errors for Native-English and Multilingual Writers

Error Type	Native-English Writing (n=45)	Multi-lingual Writing (n=49)	*Mann-Whitney U*	*z*	*r*	Sig. (2-tailed)
Global Errors						

Citation error	0	2	1057.5	-1.363	-0.141	.173
Description unclear	4	2	1049.5	-0.947	-0.098	.343
Format	1	2	1082.0	-0.510	-0.053	.610
Incomplete Abstract	11	7	990.5	-1.244	-0.128	.214
Introduction Problem	0	5	990.0	-2.190	-0.226	.028*
Lacks Descriptive Detail	1	1	1100.5	-0.061	-0.006	.952
Logic Error	3	6	1041.0	-0.913	-0.094	.361
Missing Author	3	7	1018.5	-1.190	-0.123	.234
Total Global Errors	23	32	1006.0	-0.814	-0.084	.416
Local Errors						
Apostrophe	3	7	1039.5	-0.935	-0.096	.350
Article (missing, usage)	26	100	596.5	-4.152	-0.428	.000***
Capitalization	0	13	945.0	-2.619	-0.270	.009**
Comma Missing	19	17	987.0	-1.224	-0.126	.221
Comma Splice	0	5	1057.5	-1.363	-0.141	.173
Fragment	0	2	1057.5	-1.363	-0.141	.173
Pronoun	0	0	-	-	-	-
Pluralization	3	40	621.0	-4.585	-0.473	.000***
Preposition	2	14	902.0	-2.534	-0.261	.011*
Punctuation	3	1	1051.5	-1.104	-0.114	.270
Run-on Sentence	9	12	1092.0	-0.119	-0.012	.905
Sentence Structure	5	14	954.0	-1.768	-0.182	.077
Spelling	3	15	945.0	-1.989	-0.205	.047*
Verb Subject Agreement	4	8	885.0	-2.319	-0.239	.020*
Verb Form	5	17	1020.5	-1.074	-0.111	.283
Verb Tense	16	66	558.0	-4.521	-0.466	.000***
Word Choice	7	25	839.0	-2.794	-0.288	.005**
Word Form	2	32	672.0	-4.338	-0.447	.000***
Word Missing	2	11	925.5	-2.316	-0.239	.021*
Word Order	0	1	1080.0	-0.958	-0.099	.338
Wrong Word	7	28	841.0	-2.559	-0.264	.011*
Total Local Errors	116	428	246.5	-6.504	-0.671	.000***

*$p < .05$
** $p < .01$
*** $p < .001$

First Clinical Week Reflective Essay Evaluation. In this genre, many students appeared to struggle with descriptive writing in general, and with communicating information in a logical manner. Multilingual specialists noted that paragraphing sometimes lacked cohesion, especially in the use of topic sentences and transitions, but overall, students made fewer global errors in this

genre than they did in the case study abstracts. Writing Specialists identified only three global errors in the seven multilingual-student-authored essays: two essays lacked descriptive detail and one student failed to communicate information in a logical manner. Only two global errors were identified in the nine NES student samples (Table 4). Both student populations tended to make more sentence-level errors in this assignment per writing sample, with native English-speaking writers making an average of 3.4 errors per essay compared to 2.58 for the abstract assignment and multilingual writers making an average of 12.7 errors per reflection essay compared to 8.73 for the abstract assignment. In this writing genre, the student populations made their most frequent errors in different categories. Missing commas were the most frequent error made by NES writers followed by spelling and consistency of verb tense errors, while multilingual writers' most common error category was consistency of verb tense errors followed by appropriate selection of prepositions. Only three of 21 local error categories showed significant differences between the student groups for this genre. ML student writers made significantly more errors in the selection of prepositions, overall sentence structure, and omitting a word from a sentence (Table 4). When comparing the total numbers of local errors, a large effect size was seen with ML students committing almost three times the number of errors as NES students per writing sample (U=5.0, z=-2.852, p=.004, r=-.713).

Table 4

Reflection Writing Assignment Errors for Native-English and Multilingual Writers

Error Type	Native-English Writing (n=9)	Multi-lingual Writing (n=7)	Mann-Whitney *U*	*z*	*r*	Sig. (2-tailed)
Global Errors						
Citation error	NA	NA	-	-	-	-

Description unclear	1	0	28	-0.882	-0.220	.378
Format	0	0	-	-	-	-
Incomplete Abstract	NA	NA	-	-	-	-
Introduction Problem	0	0	-	-	-	-
Lacks Descriptive Detail	1	2	26	-0.859	-0.215	.390
Logic Error	0	1	27.000	-1.134	-0.283	.257
Missing Author	NA	NA	-	-	-	-
Total Global Errors	2	3	25	-0.855	-0.214	.392
Local Errors						
Apostrophe	0	1	27.0	-1.134	-0.283	.257
Article (missing, usage)	0	3	27.0	-1.134	-0.283	.257
Capitalization	1	5	25.0	-1.009	-0.252	.313
Comma missing	6	1	21.0	-1.359	-0.340	.174
Comma Splice	1	1	30.5	-.184	-.046	.854
Fragment	3	1	25.5	-.845	-.211	.398
Pluralization	3	5	25.0	-.840	-.210	.401
Preposition	1	8	16.0	-2.004	-0.501	.045*
Pronoun	1	2	26.0	-.859	-.215	.390
Punctuation	0	6	22.5	-1.656	-0.414	.098
Run-on Sentence	0	1	27.0	-1.134	-0.283	.257
Sentence Structure	0	5	13.5	-2.516	-0.629	.012*
Spelling	5	1	21.5	-1.301	-0.325	.193
Verb Form	1	3	25.5	-.933	-.233	.351
Verb Subject Agreement	1	1	30.5	-.184	-.046	.854
Verb Tense	5	25	15.5	-1.782	-0.446	.075
Word Choice	1	5	20.5	-1.534	-0.383	.125
Word Form	1	6	25.0	-1.009	-0.252	.313
Word Missing	1	5	12.5	-2.394	-0.598	.017*
Word Order	0	2	22.5	-1.660	-0.415	.097
Wrong Word	0	2	29.5	-.282	-.070	.778
Total Local Errors	31	89	5.0	-2.852	-0.713	.004**

*$p < .05$
** $p < .01$
*** $p < .001$

Discussion

This pilot study began with a descriptive analysis of writing activities in medical laboratory practice so that instructional strategies could eventually be developed to help students achieve the necessary competencies for written communication. The survey of current MLS practitioners and faculty revealed the essential nature of writing skills in the field, including the role it plays for those with advanced practice positions (Tables 1 & 2). Although over 90% of

MLS faculty and practitioners thought that writing was an essential activity in the field, only 72% of students agreed. One student stated, for example: *It wasn't really necessary for us to write. We interpret results. It is what it is*, while a clinical practitioner wrote:

> *Writing is a key component of communication between staff of different shifts. When descriptive, clear, and concise notes are passed from shift to shift, it makes the transition smooth, but when they are not, it creates much confusion and often a delay in patient care*.

Assessment of current student writing abilities showed that although students in our program came from a wide variety of educational and cultural backgrounds, both native-English speaking and multilingual students made essentially the same types of writing errors, albeit with different frequencies in some categories. What we might overlook as speaking with an accent in oral discourse can be more problematic in written form; what the MWSp termed "writing with an accent." When conversing with a multilingual individual we don't see the punctuation errors and we might not be sensitive enough to detect the inconsistencies in verb tenses. We might also easily forgive them if they use the wrong form of an irregular verb because we can still understand their intended meaning. But in written form these errors are much more evident, and their presence may imply a general lack of quality to the reader, especially in a health care environment. In spite of the errors that were made in the student writing samples, only four contained errors sufficient enough to impede the meaning of the written passage. However, as pointed out by several of the clinical practitioners' survey comments, these errors will not be acceptable in the working environment even when they do not completely impede the meaning. Making these errors in the hospital laboratory may cause individuals to lose their jobs if communication errors result in delays of patient care or cause patients harm. But even without patient harm, continuing to make these types of errors will at the very least diminish their opportunities for salary increases, work assignments, and ultimately career advancement.

This was our first venture working with writing specialists instead of writers from within the laboratory field, and both MLS faculty and MWSp needed additional conversations along the way to clarify concepts. The multilingual specialists struggled with the global-error categories due to the highly technical vocabulary and nature of the case study abstracts. Multilingual writing specialists also had questions about how students were supposed to use the source material, such as a model abstract for comparison. They also had questions about how derivative the case study abstract could be, raising concerns about possible plagiarism. Their uncertainty may correlate to the relatively low number of errors (total 55) counted at the global level in the 94 case study abstract writing samples. It will be necessary for us to more clearly define these error types in our field and it may be helpful to include specialists in technical writing for the next level of review.

As we began this project, MLS faculty and the MWSp had difference levels of tolerance for students' writing errors that did not impede the overall understanding of the content. Through continuing discussions, the MWSp began to understand the reasons for zero error tolerance in medical practice writing and the program faculty realized that they could allow more flexibility in some genres, especially during the initial semester of the program. Faculty could then gradually build instructional lessons toward acceptable levels of competency prior to students entering their final (clinical) semester in the hospital setting.

Summary

Because approximately 70% of all medical decisions, such as patient diagnosis, treatment selection, and follow-up management, are based on laboratory results, clear, accurate and concise communication skills are essential for patient safety and optimal care. (Forsman, 2000; NPSG,

2014). The essential nature of communication for patients' laboratory results is highlighted as one of the strategic goals of The Joint Commission, the agency which accredits and certifies more than 20,500 health care organizations and programs in the United States. Goal #2 of the seven National Patient Safety Goals is to: *Improve the effectiveness of communication among caregivers. Report critical results of tests and diagnostic procedures on a timely basis* (NPSG, 2014).

Miscommunications between laboratory personnel and other health care practitioners can cause unwarranted delays in patient care and errors in treatment selection, which ultimately could result in patient harm, including the possible loss of life. Laboratory science education programs must therefore include the development of adequate oral and written communication skills, opportunities to practice and achieve communication competencies, along with the scientific content needed for effective practice in the laboratory medical field.

This pilot study was initiated because both MLS faculty and practitioners had expressed concerns about our program graduates' writing abilities. The results of the study showed that although the types of writing errors were essentially the same for native-English speaking students and multilingual students, the frequency of errors was higher among multilingual writers. Across two different writing assignment genres, multilingual students made about three times more local errors than native-English speaking students. The results of this pilot study document some of the language proficiency issues faculty have noticed for students in the program as well as provide us with an area of focus for curriculum development (Tables 3, 4). The MLS Program faculty are now more aware that their expectations for discipline specific writing abilities will need intentional and strategic development within the program's curriculum. This study shows that there is also a need to improve the basic writing skills of both

native-English speaking and multilingual students, perhaps through a series of specific prerequisite courses to develop their technical writing skills. The MLS Program faculty will also be working with the University's WEC program over the next two years to develop an intentionally designed writing plan, including new tutorial modules for student instruction and revisions to our writing assignment instructions and rubric criteria to better align with the expected program outcomes for written communication. Further studies will assess the impact of these changes to student writing outcomes.

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