Planning a Full Neurosurgery Component for an Undergraduate Medical English Word List and Pedagogical Materials

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In this article, we consider the issues involved in creating a pedagogical medical English word list and materials for undergraduate students by examining one important component of the materials: neurosurgery. In our report, we use qualitative data in the form of interviews together with documentary analysis of medical reference books and current course materials. Our findings are used to set up the concepts and categories necessary to compile a comprehensive word list, as well as to aid planning of further pedagogical materials. We describe the process of analysis and the categories that develop alongside plans for materials. We also investigate the characteristics of the neurosurgery terms themselves, with a view to determining how they can be organized efficiently to create as concise and practical a word list as possible, and how the list should combine with the learning materials for students.

The investigation documented here should be considered exploratory. It is an experimental step in moving from a course-specific medical word list for third-year students towards a comprehensive basic word list of high-value terms for medical students studying in their first four years at university. Importantly, the list will be used in conjunction with a set of materials that incorporates those words.

BACKGROUND

The research reported in this paper is part of two interlinked central-government-funded projects on medical English. An overview of the initial project, designed with the objective of developing pedagogical materials for third-year medical students, and the subsequent project currently underway to create online materials, is given below. As American English spellings are generally preferred in Japan, these are used in both our pedagogic materials and our research articles.

Creating a Word List and Pedagogical Materials for Third-year Medical Students

In the first project (Fraser, Davies, & Tatsukawa, 2015), our research was oriented towards the development of a medical word list and teaching materials for third-year university students. As Nation (2016) points out, it is important that specialized vocabulary is learned in the context of learning the subject matter of a particular field. With this in mind, the research team (Fraser, Davies, Tatsukawa) worked with subject experts (senior members of the university's medical faculty) to compile a word list whose contents were integrated with a set of teaching materials. The materials covered six areas linked to body systems (the nervous system, cardiovascular system, respiratory system, digestive system, musculoskeletal system, and endocrine system), and related diseases. In addition, a self-study unit on anatomical planes, terms of location, and views was created and added. These units of material have been presented and taught by means of an annual intensive course. We have since produced two further units, designed in consultation with the medical faculty's English specialist. The first of these added another body system (the lymphatic system), and an organ (the liver); the liver was considered important enough to merit a unit of its own.

Developing Online Medical English Materials

For this project, the research team was expanded to include an ICT specialist (Enokida), and our main aim has been to create online medical English materials for students (Fraser, Davies, Enokida, & Tatsukawa, 2017). A key reason for starting an online project was that language teacher contact time in medical English classes is very limited. At Hiroshima University, students take general English courses in their first two years, but do not begin studying medical English until their third year. Another reason is that medical English is often introduced by Japanese medical professors in a variety of ways, the most common of which is through glossaries with accompanying lecture notes (Davies, Fraser, Tatsukawa, & Enokida, 2017); also, Japanese medical textbooks frequently include English translations attached to key Japanese medical terms (Davies, Fraser, & Tatsukawa, 2014), and students may be asked to learn some of these. In addition, it is common for students to use English reference books during their courses. Regarding the medical English projects described here, if medical English materials are placed online, they can be accessible to all members of the medical teaching staff as well as students, creating a common point of focus and reference.

At the outset, the online project was oriented towards second-year students, but our strategy changed with the decision to convert to a flipped learning course for third-year students and to add a further unit (the integumentary system). This decision resulted in placing the receptive-skills-oriented parts of the original six third-year units online along with the self-study unit on anatomical planes, terms of location, and views. The same will be done for the integumentary system, lymphatic system, and liver units, and for a trial urinary system unit that was made at the start of the second project.

Challenges

<u>Creating a core medical English word list</u>

So far, the research has been conducted with materials development and word list development taking place simultaneously (Fraser, Davies, & Tatsukawa, 2015). We currently have a course-specific word list that is linked to the third-year intensive course materials. However, an overarching aim of our work is to produce a general medical English word list for undergraduates, with this list connected to a set of materials that they can study.

To produce the course-specific word list, key words have been drawn from the existing course materials and listed. Corpus analysis of two important reference books, *Gray's Anatomy for Students* and *Harrison's Principles of Internal Medicine,* has been used to identify high-value terms that have been missed (Fraser, Davies, & Tatsukawa, 2014; 2016). The units of material have then been edited in order to add the missing words to both the teaching materials and the word list. In addition, the corpus analysis has enabled us to bring the language of the materials closer to the medical discourse of the two medical texts. This parallel approach, however, presents challenges when it comes to producing a core medical English word list for undergraduates.

The need for a broader approach

The primary problems faced by the research team relate to the limited amount of time allocated to English for Medical Purposes (EMP), and to the need for creating learning materials for both doctor-doctor and doctor-patient communication. Currently, only the taking of patient histories is covered in the materials. The pedagogic units are designed to build from receptive skills to productive skills: Students first study key terms in anatomy, histology, and physiology, followed by some selected diseases; finally, they either practice doctor-patient dialogues and role plays or carry out summary writing tasks. The doctor-patient dialogues take the form of initial interviews with patients to establish symptoms.

From discussions with senior medical staff (Davies, Fraser, & Tatsukawa, 2014), it became clear that students need a set of skills extending beyond doctor-patient communication, and which accommodate the more technical side of medicine that is required both in training and in conversations between doctors. As a result, the materials we have developed cover different ground from other medical English textbooks; *English in Medicine*, for example, is oriented towards communication in English with patients, with units such as 'Taking a history', 'Examining a patient', 'Making a diagnosis', and 'Treatment'. As a consequence of our materials-building approach, the current course word list, while potentially useful outside the course, cannot be described as a 'general' medical word list. Rather, it is a course-specific list, and is restricted in scope due to the limitations faced by the teaching team under the current institutional system of classes, which allows little time for EMP. A pedagogical word list must, by definition, be oriented towards learnability, and because classroom time is limited it has become necessary for learning materials linked to the word list to now take the form of online self-study materials. The content of these materials can be linked to the medical classes being given primarily in Japanese, bolstering the limited amount of medical English teaching that takes place there. Other research, documented elsewhere in this journal (Enokida, Fraser, Davies, & Tatsukawa, 2018) has shown that, provided a sensible system of control, encouragement, and evaluation is put in place, students can, at least from a receptive skills perspective, learn a great deal by themselves.

Planning for new materials

At this point in the research, the best approach is to reflect on the limitations of our current EMP materials, and to start making provisional plans for further pedagogic materials. It is hoped that, through these materials, the current word list can be extended to create a general medical word list which contains a core of words that undergraduates should know by the end of their first four years of study. Regarding the word list, as noted above, the teaching of medical English is in fact the responsibility of both medical specialists and English teachers, and one way of coordinating efforts is to identify and share the key medical English terms that students need to study. The planning of new materials and control of vocabulary can be achieved in two ways: by documentary/corpus analysis of key texts used in undergraduate medical studies, and through dialogue with medical specialists.

Based on discussion with medical specialists, we decided to select reference books as key texts for analysis rather than research articles. While the skills needed to read and write academic articles are very important for medical specialists, in the early stages of undergraduate medical studies, the priority is different: A great deal of information has to be assimilated on gross anatomy, histology, physiology, diseases, and treatments. The way that medical reference books are structured in these areas sheds light on the key subdivisions of medicine, and corpus analysis can help identify frequently occurring words and how widely they are distributed across subdivisions such as the cardiovascular system and the nervous system. In addition, from our discussions with medical specialists, we have found that the way experts structure their own medical knowledge and understanding of key areas offers insights into what to prioritize, particularly in fields which are highly complex and rich in medical terminology.

Word list organization

A further concern is how we should go about structuring and organizing the lexical items in a list. At the level of the individual items, there is the issue of lexical complexity, including length, morphology, and word combination. For example, how should a term such as 'parasympathetic preganglionic neuron' be approached? Should it just be listed as a single entity, or do we also need to break it down into parts (*para-, sympathetic, pre-, ganglion, -ic, neuron*) that are components of many other medical terms? Also, should a word like *nerve*, familiar to most people, be taken as having the same degree of 'technicalness', and presumably difficulty, as *medulla oblongata*, a term which would only be recognized by a specialist in the field? In addition, we need to consider how words should be organized at higher levels: Would it be better to treat histology and gross anatomy separately, for instance, or should they be regarded as forming a single group?

APPROACH AND METHOD

A Body Systems Approach

The approach that embraces our methodology takes body systems as a starting point. Adopting this view emerged as a practical option in our initial research, and was based on communication with senior members of the medical faculty concerning the selection of medical journals for corpus construction. However, it soon became clear that materials development would benefit from a similar approach. Medical specialisms can often be associated with particular body systems, with obvious examples being cardiac surgery and cardiology in relation to the cardiovascular system, and neurosurgery and neurology in relation to the nervous system. However, there are branches of medicine, such as oncology, which can cover almost any area of the body, and exceptions like these will need either to be assimilated into the body systems approach or accommodated with units of their own. Word list creation can follow the body systems approach, and in compiling a list, words can be incorporated within categories. While these categories have yet to be finalized, in this article, we examine neurosurgery as a test case.

Use of Documentary Analysis and Interviews

As noted above, a neurosurgery word list can be created through documentary/corpus analysis and dialogue with medical specialists. This is the approach we have taken, and in doing so we have sought to answer the following questions:

1. What are the important areas and lexical items in neurosurgery?
2. What English language content should undergraduates study?
3. How should the pedagogical word list items be categorized?
4. What insights does the neurosurgery component offer for a general word list?

These questions are closely interlinked, and cannot be completely separated in relation to the interviews and documentary analysis used in this research. We took the decision to start with the creation of an initial neurosurgery word list which would form the focus of discussion with an experienced neurosurgeon. A documentary analysis was used to create this initial list, with items being taken from several sources: the teaching materials created by the research team; the reference books *Structure and Function of the Human Body* and *Gray's Anatomy for Students*; the websites *WebMD* and *Wikipedia;* and a medical brochure, *Basic sets of neurosurgical instruments*. The terms were listed on a spreadsheet, and rough categories were created as a starting point. The list was sent to the neurosurgeon, and the categories and contents subsequently discussed.

A second meeting was held with the neurosurgeon to discuss how the field of neurosurgery could be conceptually mapped. Prior to the meeting, the neurosurgeon was supplied with a set of questions, and at the meeting he provided a set of notes which he subsequently explained.

A third meeting with the neurosurgeon took place to consider a newly developing category in the word list: surgical verbs. The meeting provided an opportunity to gain an understanding of a surgical procedure and to think through how a surgeon describes an operation. Our results and discussion are based on the neurosurgery word list, interviews, and notes from the interviews supplied by the neurosurgeon.

RESULTS

The Initial Neurosurgery List

The initial list comprised 321 separate items, and the first step was to organize them in a systematic way. Several categories emerged from this process, partly through a review of existing materials. For example, as noted above, it was clear that the course-specific word list contained very few words to describe treatment or which were related to tests. Consequently, *treatments* and *tests* were created as categories. Most words were anatomical, and rather than try to distinguish between gross anatomy and histology, a combined category of *gross anatomy/histology* was created. Other categories which developed were *symptoms*, and the broad classification of *medical problems*. Finally, a *specialisms/specialists* category was created from the remaining words.

TABLE 1. Word List Categorization and Number of Terms

anatomy/ histology	specialisms/ specialists	medical problems	symptoms	tests	treatments
152	9	42	47	7	64

First Meeting: Neurosurgeon's Review

The first list was sent to the neurosurgeon for review with a set of questions. To help contextualize the word list, we stated a framing question: *What medical words should medical undergraduates learn by the end of their fourth year*? In relation to this key question, we also wanted to know:

1. Are the medical categories (*anatomy/histology, specialists/-isms, medical problems, symptoms, tests, treatments*) appropriate? If not, how should the list be organized from a medical point of view?
2. For undergraduates who need the basics, which terms are *not* useful at their stage of study, particularly with regard to anatomy, histology, and physiology?
3. What key terms have been missed that students ought to learn as undergraduates?
4. How should items such as *hypertension* and *hypotension* be classified? Are they medical problems, symptoms, or both?

In answering these questions and in follow-up discussions, the neurosurgeon made several points, which are summarized below:

1. The suggested categorization seemed reasonable, but *physiology* should be added to the *anatomy/histology* category.
2. The following four items should be removed from the list: *axolemma, axoplasm, neuropil,* and *distractor*. Two items required further investigation: *synaptic knob* and *cold brain*.
3. The following items should be added to the list: *anterior cerebral artery, middle cerebral artery, posterior cerebral artery, internal carotid artery, external carotid artery, anterior communicating artery, posterior communicating artery, Galen's vein, internal cerebral vein, carotid vein, blood pressure, artery, vein, speech therapist, occupational therapist, physical therapist, ward nurse, neuro-radiologist, sacular aneurysm, dissective aneurysm, dissection (a tear), anaplastic astrocytoma, anaplasty, facial spasm, DSA (digital subtraction angiography), angiography, angiogram, neurological examination, blood test, ECG (electro cardiogram), EEG (electro encephalogram), tinnitus*.
4. *Hypertension* and *hypotension* can be both medical problems and symptoms.

The most important comment concerned the omission of *physiology* in the categorization. While this exclusion was an oversight rather than a deliberate choice, it brought a key issue into focus: There were no verbs in the initial word list. Many of the words in the list had been found from scanning the chapter on the nervous system in *Structure and Function of the Human Body*. The chapter also contains a list of terms, all of which are either nouns or adjective-noun combinations. This is unsurprising for a reference book that is designed for medicine, and not as an English language teaching text. In contrast to a discourse approach to a text, from a content point of view the noun phrases immediately suggest a context. This can be illustrated by contrasting verbs in a set of sentences (*follow, shown, enters, leaves, extend, terminate*...) with nouns (*axon, sympathetic preganglionic neuron, spinal cord, anterior (ventral) root, spinal nerve, sympathetic ganglion, terminal ganglion*…).

In order to remedy the omission, the chapter was scanned both for verbs and noun forms that easily convert into verbs (*regulate* from *regulation,* for example). Because physiology is concerned with body processes, a large number of verbs can be identified in comparison to anatomy, which is focused on locations and attachments. In total, 81 verbs were added to the list as GAHP (gross anatomy, histology, physiology) verbs. Also, through Internet searches and reading, a shorter list of 30 verbs related to surgery was compiled and added. Table 2 shows the number of terms included in each of the categories.

TABLE 2. Word List Categorization and Number of Terms

anatomy/ histology/ physiology	specialisms/ specialists	medical problems	symptoms	tests	treatments	surgical verbs	GAHP verbs
182	15	62	56	15	88	30	81

Second Meeting: Neurosurgeon's Categorization of Medical Problems of the Brain

The new neurosurgery word list contained over 500 words for analysis (Appendix 2). From a practical point of view, this number of individual terms in a highly specialized pedagogical word list would present a very large learning load for students, and it was therefore necessary to find a way of prioritizing them. To do this, a further meeting was arranged with the neurosurgeon to try to get a conceptual map of the specialism. The questions themselves included examples, which might be considered leading. However, to avoid risking vagueness, and already being aware of some medical neurosurgical problems through previous research, we wanted to give a clear idea of what we were seeking. The underlying question we were trying to address was: *How is neurosurgery conceptually organized?* The neurosurgeon was sent the following questions:

1) How would you explain the key medical problems and surgical procedures of neurosurgery? (For example, should medical problems be categorized in the following way: *aneurysms, tumors, malformations, head trauma*?)
2) How should these key categories be subdivided? (Taking tumors as an example, would the subdivisions be *meningioma, blastoma*, etc.?)

In answering these questions, the neurosurgeon provided a set of notes (see Appendix 1 for transcription), and these offer an insight into the nature of medical problems and how they can be conceptually organized.

Third meeting: Discussion of a Neurosurgical Procedure

The third meeting with the neurosurgeon involved discussion of a neurosurgical procedure. The aim was to get a feel for the way that operations are described and that neurosurgical verbs are used. In the meeting the neurosurgeon described the clipping of an aneurysm, a common procedure to treat a bulge in one of the brain's blood vessels.

DISCUSSION

From an analysis of the data, a number of issues come to light which deserve consideration:

characteristics of the terms in the list; word forms in the list; items emerging from the conceptual mapping of neurosurgery; categories within the neurosurgery component of the word list; and implications for materials design.

Items Emerging from the Conceptual Mapping of Neurosurgery

When discussing tumors, the neurosurgeon indicated that more detail on the different types of tumor would be very valuable. For example, in his notes (Appendix 1), he highlighted *glioma* and *medulloblastoma* under the category of malignant tumors. He listed *meningioma, nerve sheath tumors (shwannoma), pituitary adenoma,* and *adenoma* as belonging to the benign tumors category. While the course-specific word list distinguishes between malignant and benign tumors, there are items at the next level of the brain tumor hierarchy that learners clearly also need to know. These terms also draw our attention to the suffix *-oma*, which is another high-value item.

A further issue concerns verbs used in neurosurgery (Table 3). A cursory examination of surgical verbs indicates that most of them have a wide application within the field of surgery. Two items, *core out* and *debulk,* are probably related to the treatment of tumors only.

TABLE 3. Surgical Verbs

anesthetize	aspirate	block off	clamp	close	coagulate	core out	cut	debulk	decompress	
dissect	divide	drain	drill	examine	expose	fix	incise	irrigate	manipulate	ooze	open
operate	perform	reflect	remove	retract	separate	stimulate	supply	suture	treat	

The basic steps for clipping an aneurysm show how some of the verbs are used:

1. The patient *is anesthetized*.
2. The head *is fixed*.
3. A semi-circular incision *is made* in the skin.
4. The skin *is reflected*.
5. Burr holes *are drilled* in the cranium using a perforator.
6. The bone *is cut* using a craniotome.
7. A section of bone *is removed*.
8. The dura mater *is incised* and *reflected*.
9. The surface of the brain *is exposed*.
10. Reflectors *are used to create* tension at the planned incision point of the arachnoid membrane.
11. Micro scissors *are used to cut/dissect* the arachnoid membrane.
12. A clip *is placed* on the neck of the aneurysm.
13. After successful clipping of the aneurysm the dura mater *is closed* and *sutured*.
14. The bone *is replaced* and *fixed* to the cranium using titanium plates.
15. The skin and muscles are *sutured* back into place.

Characteristics of Words in the List

Word forms in the list

Given the relative paucity of verbs in the course word list, it is important to ensure that any missing verbs are included in a more general word list. However, it should be kept in mind that the headword of many families is often taken to be a noun (consider the family ‘digestion, digest, digestive’, for example). For reasons of space, it may be that only the noun form is included, but this does not mean that the verb (or indeed other forms) is not used. We see in the surgical procedure above, for instance, that the noun *incision* and verb *incise* both appear.

This leads to the question of how word families should be shown in the list. For the course-specific word list, items are usually displayed as they appear in the pedagogic units of material; to list all forms of a word family would create a very long list, so in many cases only one form is given. In the list, this often means that the noun form is more common. In converting the course-specific list to a general word list, a simple strategy would be to place the highest-value word first, with other useful forms appearing next to it: digestion *n.* (digest *v.*, digestive *adj.*).

Another issue concerns how we should treat word combining forms, including prefixes and suffixes. The value of learning these in medicine has been highlighted by Chabner (2015). As noted above, a useful affix to know is -*oma* (meningioma); another is -*itis* (meningitis). These, and other important combining forms, should also find a place in the list.

Degrees of ‘technicalness’

When we observe the items in the neurosurgery word list (Appendix 2), it is apparent that there is a wide range of ‘technicalness’ of the terms in the list. Unsurprisingly, many of the items are highly technical terms, often of Greco-Latin origin, which are rarely found outside the subject area: *pseudounipolar neuron, mesencephalon,* and *corpus callosum,* for example. However, there are others that are at least recognizable to the layperson (e.g., *hypertension, seizure, chronic*), and yet others that are widely known, such as *brain, bleeding,* and *headache*. All these words, familiar or unfamiliar, can be considered technical, but as our interest is in a pedagogical word list, it would surely be wise to separate the lower frequency words from those ‘lay-technical’ words that should already be known.

Among the familiar words, we find those polysemous words that have been labelled ‘cryptotechnical’ (Fraser, 2012): everyday words which can be considered ‘cryptic’, in that they have a technical sense which is likely to be obscure to a non-specialist. Examples of this kind of word include many of the surgical verbs mentioned above: *fix, reflect,* and *supply,* for instance, with even *open* and *close* taking on specialized meanings in neurosurgery. There is nothing about these words that makes them intrinsically difficult; it is their potential for confusion and the fact that learners (and, equally importantly, teachers) may erroneously think that they know them that makes them an important category.

Multiword terms

If multiword units occur with sufficiently high frequency in a corpus, or are identified by a subject expert as being important terms in the field, then they should be treated in the same way as single-word terms in the list, even if their individual components are listed separately. They function in the same way, although they may consist of two or more words (often noun-noun or adjective-noun combinations such as *withdrawal reflex* and *parasympathetic preganglionic neuron*).

It is important to note, however, that many of the 'familiar' words mentioned in the previous section take on a quite different, and often highly technical meaning when they combine with other words: *thunderclap headache, white matter*, *central nervous system*. In many cases, combinations such as these cannot be split; the meaning of *white matter*, for example, cannot be discerned from a knowledge of the individual words making up the unit.

Categories within the Neurosurgery Component of the Word List

In relation to the categorization of pedagogic word list items within the neurosurgery component, it is important to establish broad divisions that represent a conceptual structure. Although having too many categories will cause confusion and be likely to result in overlap, a list with few or no categories will be inflexible. For example, if the list is being used in the wider context of medical teaching rather than for specific courses, medical teachers may wish to refer students to terms specifically related to treatment.

In the process of compiling a list of terms (see Appendix 2), eight working categories emerged: *GAHP, specialists/-isms, medical problems, symptoms, tests, treatments, surgical verbs,* and *GAHP verbs*. Clearly, this number of categories can, and should be, reduced. For example, in the process of the research described here, having a surgical verb section is useful, but regarding a final pedagogical word list, the surgical verbs should be assimilated into the treatment category, and the GAHP verbs into the GAHP category.

The GAHP category, comprising gross anatomy, histology, and physiology, is a large one, covering three major areas. The reason for keeping it as a single category is that from a pedagogical point of view, it is difficult to separate these three areas. In creating pedagogical units of material, it has often been necessary to intertwine the two levels of anatomy and body processes. Also, when we examine *Structure and Function of the Human Body*, a key text used by the students, it becomes apparent that talking about body systems requires the integration of all three areas.

A further question concerns the relationship between medical problems and symptoms, and particularly the problem of overlapping categories. Items such as *hypertension* and *hypotension* were discussed with the neurosurgeon, who confirmed that they can be categorized under both headings. Again, from a research point of view, having two categories is useful, but for a pedagogic word list, a single category of medical problems and symptoms is a more practical option. An awkward category is *specialisms/-ists*, which is small enough to be assimilated into *treatments*. Another category containing a small number of items is *tests*. However, while not large, it is obviously an important category. Consequently, the four categories for a final word list neurosurgery component are: *GAHP, medical problems and symptoms, tests,* and *treatments*.

Categorization of Medical Problems

The second meeting with the neurosurgeon showed how an experienced medical practitioner organizes the medical problems within his specialism. Also, in his explanation, the neurosurgeon listed problems dealt with by neurologists, which fits with the body systems approach of our research; the nervous system is the focus of both neurosurgeons and neurologists. The key categorization terms are: *cerebrovascular disease (CVD)*, *brain tumor*, *anomalies*, *functional disease*, *infectious disease*, *degenerative disease*, and *trauma*. It should be noted that only *cerebrovascular disease* and *brain tumor* appear to be specific to the nervous system; the other categories are also likely to appear in medical fields relating to other body systems.

Within the broad categories, some key words and word parts can be identified. In the CVD category, important words are *aneurysm*, *hemorrhage*, *infarction*, *stroke,* and *malformation.* Regarding tumors, a key item is the word part *-oma*, denoting 'tumor', 'mass', or 'swelling'. With infectious diseases, the suffix *-itis,* meaning inflammation, is evident. Once these words and combining forms making up a term are identified, the other parts of the term tend to be locational. *Subarachnoid* locates a problem beneath one of the meninges, the arachnoid membrane; *subdural* locates a problem beneath another meninx, the dura mater; *intracerebral* locates a problem within the cerebrum.

Implications for Materials Design

Content

An important aspect of the project is to ensure that the terms in the word list are embedded in materials that the students study. The word list, therefore, emerges in the process of materials development, which in turn is steered through interviews with medical specialists and documentary research, including corpus analysis.

As noted earlier, the pedagogical materials involving role plays are oriented towards history taking, so that treatment is not usually covered. In the case of our neurosurgery unit, students study chronic subdural hematomas, subarachnoid hemorrhages, aneurysms, and brain tumors. The analysis in this article indicates the importance of extending the units of materials to cover treatments, and here the conceptual mapping of neurosurgery is important. More detail on the types of tumor that neurosurgeons deal with should be incorporated into the treatment sections; this will expand the number of medical problem words, and it may also have a washback effect on GAHP terms. For example, having 'astrocytoma' as a medical problem will probably lead to the inclusion of 'astrocyte' in the GAHP category. Such items can be incorporated into the neurosurgery unit of the materials by adding online essays with complementary word exercises. These words will then be listed in the course word list to make the neurosurgery component a general one. In a similar way, describing the surgical procedures used to treat the medical problems will ensure coverage of the surgical verbs.

Combining units of meaning

A further important consideration is how to sensitize students to the ways in which words and word parts combine. While some medical English courses consider an affix-driven approach where prefixes, suffixes, and other combining forms are learned first, this only seems possible if students already have sufficient medical vocabulary to start identifying the word parts (MacDonald, 2015). A main aim of our project is to build up students' vocabulary within the context of medical discourse. As they explore the medical English of a field such as neurosurgery, certain affixes and combining forms can be highlighted. For example, when students read about the meninges, meningioma, and meningitis, clearly it is useful to sensitize them to the relationship between the three terms. In this sense, affixes can be taught opportunistically. This can be achieved through the development of exercises that focus on lexical relationships, as it can by no means be assumed that students are able to break words down into their constituent parts, or identify even basic affixes such as *hyper-, hypo-, inter-, intra-,* and *sub-*.

CONCLUSION

In this article, we have used documentary analysis combined with interview data to sketch a plan for creating a neurosurgery component of a general medical English word list for undergraduates, along with pedagogical materials that have the words embedded in them. In the analysis, four categories for the word list items have been created: GAHP, medical problems and symptoms, tests, and treatments. The words to be added to the list will emerge in the process of materials development, in which items will be carefully selected for incorporation. For example, while it would be possible to create materials on treatment that describe tumors simply as malignant or benign, our findings from interviews and documentary analysis indicate that a focus on particular types of tumor, such as meningiomas or astrocytomas, will be much more useful in helping students to build up a core medical vocabulary.

Future research will focus on creating extended materials that can be accessed by medical students online, along with the resulting expansion of the word list to incorporate such terms. While this is a slow process in contrast to certain kinds of specialized word list development (e.g., approaches relying on examination of existing texts and dictionaries), it has the advantage of creating a list that is embedded in pedagogical materials, easily accessible for students. If, as with the neurosurgery component, medical experts are able to share their insights with the applied linguistics team, our approach will, importantly, have the added strength of content guidance by specialists in the field.

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APPENDIX 1. Notes on Neurosurgery

neurosurgery

- cerebrovascular disease (cvd)
  - subarachnoid hemorrhage (aneurysm, vasospasm, rupture)
  - brain infarction, hemorrhagic stroke
  - hypertensive intracerebral hemorrhage
  - vascular malformation
- brain tumor
  - malignant tumor
    - glioma (astrocytoma, anaplastic astrocytoma, glioblastoma)
    - medulloblastoma
    - others
  - benign tumor
    - meningioma
    - nerve sheath tumor (schwannoma)
    - pituitary adenoma
    - adenoma (angioma)
- anomalies
  - hydrocephalus
  - arteriovenous (AV) malformation (also CVD)
- functional disease
  - trigeminal neuralgia
  - facial spasm

neurology (usually)

- infectious disease
  - meningitis
  - encephalitis
- degenerative disease
  - multiple sclerosis
  - Parkinson's disease
  - dementia
  - spinal stenosis
- injury (trauma)
  - acute epidural hematoma
  - acute subdural hematoma
  - chromic subdural hematoma
  - brain contusion, brain swelling
  - peripheral nerve injury
  - traumatic subarachnoid hemorrhage

- **surgery**
  - direct surgery
    - clipping of the aneurysm
    - removal of the tumor
    - removal of the hematoma
    - removal of the AVM
    - irrigation of the hematoma
    - stereotactic neurosurgery
    - carotid endarterectomy
  - endovascular surgery
    - coiling of the aneurysm (catheter)
    - angioplasty
    - carotid artery stenting (CAS)

- wire saw
- twist drill
- spatula
- foot switch
- shunt scissors
- scalpel
- air douche
- bipolar forceps
- bone punch
- bone rongeur
- burr hole
- chisel
- curette
- director
- dissector
- elevator
- hemostasis
- hook
- intubate
- micro scissors
- anesthesia
- power tool

- **conservative treatment, rehabilitation**
  - medication
    - chemotherapy, anticonvulsant, antiemetic drug, dexamethasone, diuretic, furosemide, painkiller, statin
  - radiotherapy
    - conventional radiation, gamma knife (radiosurgery)

APPENDIX 2. Neurosurgery Word List for Analysis

GAHP
abducens nerve
accessory nerve
acetylcholine
action potential
adrenergic fibres
afferent/sensory neuron
anterior cerebral artery
anterior communicating artery
antidiuretic hormone
apolar neuron
arachnoid membrane
arachnoid sheath
artery
astrocyte
astroglia
autonomic
autonomic ganglion
autonomic nervous system
axon
axon terminal
basal nuclei
bipolar neuron
blood pressure
blood-brain barrier
brain
brain stem
carotid vein
catecholamine
central nervous system
cerebellum
cerebral cortex
cerebrospinal fluid
cerebrum
cholinergic fibres
choroid plexus
conduction
corpus callosum
cranium
cranial cavity
cranial nerve
cytoplasm
dendrite
dermatome
diencephalon
dopamine
dura mater
effector
efferent neuron
endoneurium
endorphin
enkephalin
ependymal cell
epineurium
external carotid artery
facial nerve
fascicle
femoral artery
fibrous
fibrous astrocyte
fissure
fontanelle
frontal lobe
Galen's vein
glial cell
glia
glossopharyngeal nerve
Golgi type I
Golgi type II
gray matter
gyrus/gyri
hemisphere
hypoglossal nerve
hypothalamus
integration
internal carotid artery
internal cerebral vein
interneuron
limbic system
lumen
macroglia
medulla oblongata
melatonin
meninx/meninges
mesencephalon
microglia
midbrain
middle cerebral artery
motor neuron
multipolar neuron
myelin sheath
myelinated axon
myelinated fiber
nerve impulse
neurilemma
neuroglia
neuron
neurosecretory neuron
neurotransmitter
neurovascular bundle
nitric oxide
nodes of Ranvier
norepinephrine
neurilemmal sheath
oculomotor nerve
occipital lobe
olfactory nerve
oligodendrocyte
oligodendroglia
optic nerve
parasympathetic
parasympathetic division
parasympathetic ganglion/ganglia
parasympathetic postganglionic neuron
parasympathetic preganglionic neuron
parietal lobe
pedicel
perikarya
perikaryon (cell body)
perineurium
periosteum
pia mater
pineal gland
pituitary gland
planning
plexus
pons
posterior cerebral artery
posterior communicating artery
postganglionic neuron
postsynaptic neuron
preganglionic nerve
preganglionic neuron
presynaptic neuron
presynaptic neuron
process
protoplasmic
protoplasmic astrocyte
pseudounipolar neuron
pyramidal cell
reception
receptor
reflex
reflex arc
relaying
reticular formation
saltatory conduction
satellite cell
Schwann cell
sensory neuron
serotonin
somatic
somatic nervous system
spinal cord
spinal ganglion
spinal nerve
Splanchnic nerve
subarachnoid space
sulcus/sulci
sympathetic
sympathetic division
sympathetic ganglion
sympathetic postganglionic neuron
sympathetic preganglionic neuron
synapse
synaptic cleft
synaptic contact
synaptic knob
telencephalon
temporal lobe
thalamus
tract
trigeminal nerve
trochlear nerve
unipolar neuron
vagus nerve
vein
ventral root
ventricle
vestibulocochlear nerve

visceral effector
white matter
withdrawal reflex

SPECIALISTS/-ISMS
anesthetist
circulating nurse
neuro-oncology
neuro-radiologist
neuroscientist
neurosurgeon
occupational therapist
ODA
physical therapist
psychiatric nurse
psychiatrist
psychologist
scrub nurse
speech therapist
ward nurse

MEDICAL PROBLEMS
acute subdural hematoma
anaplastic astrocytoma
aneurysm
angioma
arterio-venous malformation
astrocytoma
benign tumor
blastoma
bleeding
brain swelling
brain tumor
case
catastrophic stroke
cerebral infarction
cerebrovascular accident
chronic subdural hematoma
compression
cytoma
dementia
dissection (a tear)
dissective aneurysm
germinoma
glioblastoma
glioma
head trauma
hemangioblastoma
hemorrhage
hemorrhagic stroke
high blood pressure
history
hydrocephalus
hypertension
hypotension
infiltration
intracranial pressure
ischemic stroke
malignant tumor
medulloblastoma
melanoma
meningioma
meningitis
metastatis
multiple sclerosis
myelin disorder
neck
nerve sheath tumor
neurinoma
Parkinson's disease
peripheral nerve injury
pituitary adenoma
rupture
ruptured aneurysm
saccular aneurysm
spinal cord trauma
spinal disc herniation
spinal stenosis
subarachnoid hemorrhage
trauma
trigeminal neuralgia
unruptured aneurysm
vascular malformation
vasospasm

SYMPTOMS
apathy
blackout
blurry vision
burning sensation
change in mood
cognitive and behavioral impairment
cold brain
confusion
decreased vision
delusions
dilated pupil
disorientation
dizziness
double vision
drowsiness
dysphasia
edema
exhaustion
facial spasm
fainting
hallucinations
hand tremors
headache
hemiparesis
hypoxemia
impaired consciousness
impotence
irritability
leaking of fluid
lethargy
light-headedness
loss of consciousness
loss of inhibition
metallic taste
migraine
nausea and vomiting
neck pain
neuralgia
nose bleed
numbness
paralysis
paranoia
personality change
polycythaemia
ringing in the ears
seizure
sensitivity to light
shoulder pain
slurred speech
spacial problems
stiff neck
sweating
thunderclap headache
tinnitus
unconsciousness
vertigo

TESTS
angiogram
biopsy
blood test
consent form
CT scan
CTA (CT angiography)
DSA (digital abstraction angiography)
angiography
ECG (electro cardiogram)
EEG (electro encephalogram)
lumbar puncture
MRI scan
neurological examination
nuclear medicine imaging
pulse
X-ray

TREATMENTS
air douche
amyloid angiopathy
anaplasty
angioplasty
anticonvulsant medication
antiemetic drug
antiseptic
applicator
asepsis
balloon embolization
bipolar forceps
bone punch
bone rongeur
burr
burr hole trephination
cannula
catheter
chemotherapy
chemotherapy
chisel
clip (titanium)
clipping
coil
coil embolization
coiling
conductor
corticosteroid

craniectomy
craniotome
craniotomy
curette
cutting burr
cytoreduction
deep brain stimulators
dexamethasone
director
dissector
diuretic
drain
drape
drill brace
elevation
elevator
endotracheal intubation
epilepsy neurosurgery
external ventricular drainage
flat drill
forceps
furosemide
general neurosurgery
glucocorticoid
hemostasis
hook
impactor
incision
informed consent
inoperable
intubate
micro scissors
neuroanesthesia
operable
painkiller
power tool
probe
radiosurgery
radiotherapy
rib raspatory
robot
saline solution
scalpel
scissors
shunt
single-pedal foot switch
spatula
spinal neurosurgery
statin
stent
stereotactic neurosurgery
sucker
suction cannula
suction tube
surgery
surgical
surgical evacuation
transluminal balloon angioplasty
twist drill
ventriculostomy
wire
wire saw

SURGICAL VERBS
anesthetize
aspirate
block off
clamp
close
coagulate
core out
cut
debulk
decompress
divide
drain
drill
examine
expose
fix
incise
irrigate
manipulate
ooze
open
operate
perform
reflect
remove
retract
separate
stimulate
supply
treat

GAHP VERBS
accumulate
adjust
affect
allow
assist
attach
bring
bulge
bundle
call
carry
cause
cease
circulate
classify
compose
conduct
connect
consist of
contain
continue
contract
control
cover
depolarize
destroy
distribute
elevate
elicit
embed
encounter
enlarge
enter
extend
form
function
generate
initiate
involve
kill
leave
lie
line
locate
lose
maintain
make up
measure
move
myelinate
prevent
produce
protect
provide
receive
recover
regenerate
regulate
release
repolarize
resemble
result
run
secrete
seep
send
sense
separate
serve (as)
signal
stimulate
support
surround
switch
terminate
transfer
transmit
travel
trigger
vary
wrap

ABSTRACT

Planning a Full Neurosurgery Component for an Undergraduate Medical English Word List and Pedagogical Materials

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In this article, we document the background research into high-value items for a neurosurgery component of a general medical English word list for undergraduates. The research involves construction of a neurosurgery word list through initial documentary analysis, and the development of a more comprehensive list through interviews with an experienced neurosurgeon in relation to the initial list. The results of the interviews have been used to create four general categories within the neurosurgery component: Gross Anatomy/Histology/Physiology (GAHP), Medical Problems and Symptoms, Tests, and Treatments. Regarding individual items for the list, we consider the issues of word forms, degrees of 'technicalness', and multiword terms. We then discuss how these may affect organization of terms within the four categories of the list. We also consider the implications for materials design in order to ensure that terms in the general word list are incorporated in the materials for students. This can be achieved by extending currently existing online materials. A further issue relating to materials design is how to sensitize students to the ways in which words and word parts combine to form medical English terms.

要　約

医学生のための包括的な脳外科学の構成要素を扱う英語語彙リスト作成と教材開発

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本稿では，学部生を対象として，基本的な医学英語語彙リストに必須である，脳外科学の構成要素における重要性の高い事柄に関する基礎研究を記述する。研究手法としては，初期段階の文献分析を通して脳外科学語彙リストを構築し，それを経験豊かな脳外科医への面談やチェックを通してより包括的なものに仕上げた。複数回の面談により，脳外科学の構成要素を 4 つに分類することとした。(1) 肉眼的解剖学，(2) 組織学，(3) 生理学，そして (4) 医学的問題とその症状，検査，治療である。リストに載せたそれぞれの語彙について，語の成り立ち，専門性の程度，複数語から成る述語などの問題を検討した。その後，これらの問題が 4 つの分類の語彙構成にどのように影響を与えているかを議論する。そして，包括的な語彙リストの用語を学生用教材にうまく取り込むことが可能となるように，教材開発のための示唆を考えてみる。この知見は，現在までに開発・提供している医学英語オンライン教材にも活用された。今後の教材開発に関わる研究課題としては，語彙と語彙を形作る要素がどのよう組み合わさって医学英語用語を作るかについて，どのようにして学生により確実な気づきを促すかを検討することであろう。