Development of Specialized Hand-held Electronic Dictionaries with Special Reference to Those for Medical Professionals and Students

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ABSTRACT

In the course of 25 years of their existence, hand-held electronic dictionaries (HHEDs) have become more comprehensive in terms of content and more sophisticated technologically. One dimension in which the specification of these devices has advanced is the subject field of HHEDs. Medicine is one prime example of this trend. Medical HHEDs, which include many specialized, not readily accessible print dictionaries, save the user considerable time and effort. The HHED’s electronically enhanced navigability makes almost redundant the rules and conventions associated with consultation of print dictionaries. The market of medical HHEDs has been dominated by Casio and Seiko Instruments Inc. (SII). Each manufacturer contracted a block of publishers to supply contents for its respective set of products. With SII’s withdrawal from the HHED business, Stedman’s Medical Dictionary and its Japanese version were included in Casio’s HHED. The integration of a source dictionary and its translated version to be exploited for bi-directional consultation and learning in either language can be a useful, potential avenue for the next generation of HHEDs, in the environment rendered more competitive by a wide array of smart devices with Internet connectivity.

Keywords: hand-held electronic dictionary, medical dictionary, organization, print dictionary, specialized dictionary

INTRODUCTION

Hand-held electronic dictionaries (HHEDs) are stand-alone devices that make possible a flexible and comprehensive use of included reference and other works with electronically enhanced search methods. These electronic products are popular predominantly in East Asia (Yamada 2009, Ding 2015, etc.); however, they are not well known to the rest of the world. Having a quarter century tradition behind them in Japan, HHEDs have become commonplace among senior high school and university students. In the course of their development, electronic dictionaries diversified to cater to specific needs of users and subject fields. There are special HHEDs intended for medical professionals by Casio and SII (Seiko Instruments Inc.). This paper looks at those medical HHEDs in the development of the electronic devices in general, compare the use of Stedman’s Medical Dictionary (Stedman’s MD) and its Japanese version Stedman’s English-Japanese Medical Dictionary (Stedman’s E-J MD) in book and electronic forms (adapted for use in HHED). The paper also looks into the possibility of a source/translation dictionary pair as parallel texts to be manipulated for various purposes in the medium of HHED as a direction for future development.

OVERVIEW OF HHEDS

GENERAL CHARACTERISTICS

Yamada (2013, p. 158) mentions seven advantages that set HHEDs apart from other types of reference works: ease, speed, flexibility and exhaustiveness of reference; portability; versatility; and consultation self-sufficiency. Sekiyama also refers to several practical benefits:
The ability to access detailed information by jumping across hundreds of dictionaries, the ability to use them immediately after powering on, long battery life and the lack of distraction due to the absence of internet connectivity are among the advantages of HUEDs³.

(Sekiyama 2016a, p. 25)

Among the most recent and advanced HHED, Casio’s XD-G2000 (2017), for example, is intended for professionals, such as researchers and translators. The dimensions are 148.0x105.5x18.5mm (when closed), weighing 265g. The retail price is about 43,500 JPY (395 USD). Special features include: 200 reference and other works, additional materials to be added by downloading and through SD cards, human voice audio recordings, 3,000 works of literature (2,000 Japanese and 1,000 English), 2,000 extracts of classical music pieces, touch panel, color liquid crystal display screen, sturdy frame, power by two AA size batteries⁴.

DEVELOPMENT OF HHEDS IN JAPAN

According to Sekiyama (2016b), the history of Japan’s HHEDs began with TR-700 (1991) by SII (then Seiko Instruments & Electronics Ltd.)⁵. It was an epoch-making product, which included the following three dictionaries:


Sekiyama (ibid.) divides the ensuing quarter of a century of development of HHEDs into four stages, pointing out important innovations, functions, and facts.

First stage (1991-1999):
-“Jump” function: allowed the user to highlight a word in a dictionary text to go to the entry to check the word’s meaning in another included dictionary
-Phrase search: enabled the user to access a phrase entry from any content word involved in the phrase

Second stage (2000-2002):
-Incremental search: indicated candidate words as the searched word was being typed by the letter
-Example sentence search: culled all example sentences including entered key words from a dictionary included in an HUED⁶
-HUEDs outsold hand-held electronic vocabulary books in 2002 and onward.

Third stage (2003-2006):
-The frame became sturdy enough to endure the commutes to high school.
-Multiple-dictionary search: allowed the user to consult appropriate types of included dictionaries simultaneously without designating any
-Hopping between the included dictionaries became possible.
-Competition intensified between HUEDs for the number of works to include. For example, Casio’s XD-GT 6800 boasted 100 works.

Fourth stage (2007-present):
-Competition came from smart devices, such as smartphones and tablet computers.
-The number of works included leveled off at 200. Instead, HUEDs incorporated radio and TV English language programs’ to differentiate themselves from smart devices.

DIVERSIFICATION TO CATER TO SPECIFIC USER NEEDS

Since an early stage, HHEDs have been devised with the needs of English-Japanese translators, business people, and learners of foreign languages in mind. After the mid-2000’s, in an effort to reach more audiences, products have diversified. Specification has developed along three lines: the target users’ ages and education levels (adults and college students down to elementary school students), subject categories (languages, law, medicine, etc.), and professions (translators, researchers, etc.) (Yamada 2014, p. 2).
Medical HHEDs are subject-specific products as will be detailed in the next section. There are also such electronic dictionaries in other subject fields. The first of those HHEDs are listed below with a few important specialized dictionaries included.

**Engineering:** SII’s SR-G8000 (2007)\(^8\) was intended for engineers, including the following dictionaries:


**Law:** Casio’s XD-ST9200HR (2006) targeted legal professionals and students, including:


**Nursing:** Manufactured by Casio and marketed by Igakushoin (publisher), IS-N1000 (2005) is the first of the regularly updated and expanded series of HHEDs meant for practicing and prospective nurses. The latest 11\(^{th}\) edition IS-N11000 (2017)\(^9\) incorporates 70 reference works and other resources, including:


Also included are 60 instructional videos. Purchasers are offered a three-year access right to Igakushoin’s online versions of *Nursing Dictionary* and *Pocket Medical Dictionary* (2002).

**Physics, chemistry, and mathematics:** Casio’s XD-U9850 (2014) is produced for students of physics, chemistry, and mathematics, incorporating:


**RECENT INNOVATIONS**

The HHED as a stand-alone device possesses several advantages. As mentioned in GENERAL CHARACTERISTICS, one of them is consultation self-sufficiency, which allows the user to check an unknown word when reading a foreign language newspaper on the train, for example. However, this supposed strength can also have adverse effects, for instance, in writing on the computer. One has to go back and forth between the computer and the HHED: typing in a search word into the hand-held device and typing again the elicited information (words or phrases) onto the computer screen. To avoid this inconvenience, SII developed the “Pasorama” technology. It enables the user to manipulate the dictionary data in an HHED from the computer keyboard, with the HHED connected to the computer with a USB cable. It is possible to cut and paste into and out of the HHED with the mouse, bypassing the keyboard completely (Yamada 2014, p. 5).

Independence from the Internet has won the HHED trust among users. Information from the included works is limited but reliable, while information on the Internet is vast but of uneven quality. In an effort to combine both advantages, SII equipped their “Dayfiler” line
of products with Internet access via Wi-Fi.

There has been emphasis shift from reference to learning. As Sekiyama (2016b) points out, HHEDs are more concerned with helping the user’s learning than with expanding the list of works included, to compete against smart devices with an Internet connection. This is reflected in kinds of works included and in functions. As far as English is concerned, recent HHEDs incorporate the following kinds of books and materials, in addition to preparatory materials for the TOEFL® and TOEIC® tests and listening textbooks: radio and TV English language programs (see Note 7), and pronunciation evaluation devices. In 2016, Casio introduced “English Training Gym” for users to manage their study of English, making use of the materials included in an HHED. A medical HHED, XD-Y5900MED, is equipped with this function. On the default screen of English Training Gym, there appear four banners, entitled vocabulary, listening, speaking, and test preparation. All relevant included resources are categorized under these headings. A touch upon a banner shows the list of selected materials on the screen. The user chooses one material and start work on it. The English Training Gym keeps record of and shows the progress both numerically (in fractions) and visually (in graphs) to help the user to study effectively, while maintaining motivation.

MEDICAL HHEDS

It was also in the mid-2000’s that HHEDs for medical professionals and students were launched by SII and Casio. This section looks at the first and the most recent products by these manufacturers, comparing the included medical reference works. I will highlight Stedman’s MD and its Japanese translation Stedman’s E-J MD, both of which are included in Casio’s XD-Y5900MED. A comparative study will be made of this pair of medical dictionaries in print and electronic forms to explore the implications of the digitalization by means of HHED on dictionary organization, description, and consultation.

PIONEERING DAYS

The first medical HHED is SII’s SR-T6800 (2004; 65,000JPY, 590.9USD). The following nine dictionaries were included:

Stedman’s E-J MD. 5th ed. 2002. Medical View (105,000 refs., 700 illus.).
Kenkyusha’s English-Japanese Dictionary for the General Reader. 2nd ed. 1999 (270,000 refs.).
Concise Oxford Thesaurus. 2nd ed. 2002.

A comprehensive medical dictionary Stedman’s E-J MD was incorporated for the first time. Only the textual content was included in the electronic dictionary, and the over 700 illustrations and diagrams were provided in the accompanying booklet. The Japanese-English index was integrated, which made it possible to access the information arranged under English headwords also by keying in Japanese terms.

In the same year, Casio launched XD-V5200MED. The product incorporated the following nine dictionaries. Apart from a few overlaps, distinct dictionaries were included from SII’s HHED:

4
Gyakubiki Kojien [reverse Kojien dictionary]. 1999. Iwanami. [also in SR-T6800]
Kanjigen [Chinese character dictionary]. 1994. Gakken. [also in SR-T6800]
Eigo Ruigo Jiten [English thesaurus]. 1998. Taishukan

From the comparison of the included works, it is obvious that there are tie-ups between manufacturers and publishers. Nanzando and Nankodo are in the Casio bloc, and Medical View and Igakushoin are in that of SII.

At the end of this section, to assess the benefits and convenience brought to medical students by the HHEDs, let us consider the situation before the appearance of SR-T6800 and XD-V5200MED. In those days, in reading medical papers, students had a choice of the following types of dictionaries in different media to consult, but had to use them individually in prioritized combinations:

- Large medical English-Japanese dictionaries in book form or on CD-ROM (e.g., Stedman’s E-J MD)
- Large general English-Japanese dictionaries in book form, on CD-ROM, or in HHED (e.g., Kenkyusha’s English-Japanese Dictionary for the General Reader)
- Databases in book form or on CD-ROM (e.g., 180-mango Taiyaku Dai-jiten Ei-wa
- Wa-ei [1.8 Million-word Database of English-Japanese and Japanese-English Technical Terms])

SR-T6800, including the first two of the above-mentioned dictionaries, is supposed to have saved the student a considerable amount of time and effort. The user was freed from (a trip to the library and) the trouble of locating and then flipping throughout a bulky dictionary or a long wait from starting dictionary software. The incremental search lessened the trouble of recalling and typing a search word in full. Also, even though the multiple-dictionary search was not introduced yet, the need to retype a search word for an additional search with a different dictionary was eliminated, with a press of a dictionary selection key, the jump function, and the backtracking function (record of past consultations).

The market for medical HHEDs had been dominated by Casio and SII until 2015 when the latter withdrew from the HHED business altogether. Each manufacturer produced one or two medical HHEDs per year. Since 2007 Casio has rolled out a series of high-end products, making them more sophisticated yet affordable each year.

**STATE OF THE ART**

Let us look at the state of the art of medical HHEDs by comparing the most recent and advanced products from Casio and SII: XD-Y5900MED and DF-X11001, respectively. Table 1 summarizes the launch years, retail prices, and the numbers of works included.

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Casio</th>
<th>SII</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product no.</td>
<td>XD-Y5900MED</td>
<td>DF-X11001</td>
</tr>
<tr>
<td>Launch year</td>
<td>2016</td>
<td>2015</td>
</tr>
<tr>
<td>Price</td>
<td>97,200 JPY (883.6USD)</td>
<td>76,000 JPY (690.9 USD)</td>
</tr>
<tr>
<td>No. of works included</td>
<td>110 works</td>
<td>27 works</td>
</tr>
</tbody>
</table>

Generally, Casio and SII pursue different approaches in terms of the number of works included. As far as medical resources are concerned, XD-Y5900MED includes eight works
and DF-X11001 seven. One of them is common, four are similar, and the others are different (see Table 2 below). Stedman’s E-J MD is included in both HHEDs. The Japanese-translated medical dictionary had been in SII’s line of medical HHEDs since the first product. The dictionary and the source dictionary Stedman’s MD went into Casio’s HHED for the first time in 2016, when SII’s exclusive contract with Lippincott Williams & Wilkins ended with the manufacturer’s withdrawal from the HHED business. Though with different titles, Casio’s and SII’s HHEDs include one resource from each of these categories: Japanese medical dictionaries, reference works for abbreviations, therapeutic agents, and medical English conversation. In addition, Casio’s product uniquely includes another English-Japanese medical dictionary and a work on clinical examinations, and SII’s a dictionary of medical English usage and a medical English listening material.

<table>
<thead>
<tr>
<th>TABLE 2: Resources on Medicine Included in HHEDs</th>
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<tbody>
<tr>
<td><strong>Casio’s XD-Y5900MED</strong></td>
</tr>
<tr>
<td><strong>Common</strong></td>
</tr>
<tr>
<td><strong>Japanese Med. Abbreviation</strong></td>
</tr>
<tr>
<td><strong>Therapeutics</strong></td>
</tr>
<tr>
<td><strong>Med. English Conversation</strong></td>
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<tr>
<td><strong>Different</strong></td>
</tr>
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</tbody>
</table>

**COMPARISON OF MEDICAL DICTIONARIES IN PRINT FORM AND HHED**

This section closely examines Stedman’s MD and its Japanese-translated edition Stedman’s E-J MD, comparing the print versions and the electronic ones, included in Casio’s XD-Y5900MED. First, let us look briefly at the history and characteristics of Stedman’s MD and its Japanese translation.

**OVERVIEW OF STEDMAN’S MD AND STEDMAN’S E-J MD**

**Stedman’s Medical Dictionary.** 28th ed. 2006. Baltimore: Lippincott Williams & Wilkins. (1+2,169+APP176 pp., 107,000 refs., 1,000 illus.; 6,154JPY [55.9USD])

Now in its 28th edition, Stedman’s MD is considered one of the most comprehensive reference works for those involved in healthcare. The origin of the dictionary can be traced back to “the first American medical dictionary,” A New Dictionary of Medical Science and Literature (1st ed. 1833) by Robley Dunglinson (Stegman & Branger 2006). The dictionary was published to the 23rd and final edition (1903), which was edited by Thomas Lathrop Stedman (1853-1938), who was “a prominent New York physician and distinguished medical editor and author” (Hensyl 1980). In 1908, Stedman started preparation for A Practical Medical Dictionary (1911) with the intention “to challenge the two preeminent medical dictionaries of the time which he believed persisted in not correctly spelling terms in accordance with their derivations and therefore debased the medical language” (ibid.). He engaged in work on his dictionary into the 14th edition, which was published in 1939 posthumously under his name as “Stedman’s Medical Dictionary.”
The latest 28th edition (2006) deals with over 107,000 terms, with 5,000 new entries. The editorial board of medical and scientific consultants, the concept of which was introduced in the process of preparing the 20th ed. (1961) in response to expanding medical science (ibid.), consisted of 48 consultants covering 47 medical specialties. Illustrations have been updated and increased to 1,000 from 900 in the previous edition (2000). They are interspersed in the dictionary body and are included in the middle matter19.

As a unique feature of an English medical dictionary of this size, usage notes are included which are extensive and systematic to draw users’ attention to common errors in medical usage: sense, spelling, pronunciation, and style (see abscess in Appendix A). Utility of these notes for ESL users of the dictionary is mentioned in the preface.


Stedman’s E-J MD was published in 1980 as the Japanese-translated version of Stedman’s MD (23rd ed., 1976). Revision of the Japanese version has been conducted almost every five years since, the latest 6th edition being based on the 28th edition of the original dictionary. Seventy-three leading experts were involved in the last revision of the Japanese version. Although it reflects the changes introduced to the original dictionary, the Japanese edition is not a mere translation of the source dictionary. There are special features and considerations introduced with Japanese users in mind. The most noteworthy is the Japanese-English index in the back matter. The 432-page index with 9,000 terms provides an added access route, enabling users to consult the wealth of information organized by English headwords, staring from Japanese as well. Other special features include the indication of pronunciation of foreign names in the Japanese katakana syllabary, and additional glosses and explanations with consideration to the Japanese situations.

**ORGANIZATION OF PRINT DICTIONARIES**

To deal with the extensive vocabulary of medical and related sciences, consisting largely of multiple-word terms (cf. Landau 2001, p. 108), in the form of dictionary, Stedman’s MD employs niching – subentries are arranged alphabetically under main entries. Cross-references abound, for, where there is more than one synonymous term, the definition is only provided for one of them, to concentrate information and to keep the dictionary within manageable size (pp. xliii-xliv). As far as print dictionaries are concerned, building an efficient system with organization compatible with accessibility requires the dictionary to adopt a numbers of rules, conventions, and ingenuities at various levels and the user to be familiar with them (including exceptions) to navigate through the dictionary in search of information. This sub-section looks at how meticulously information is organized in the two print dictionaries20 and how access is enhanced in the HHED.

**ENTRY DEMARCATION**

The divisions of entries provide users with important information in consulting a print dictionary. This is even more relevant for the users of Stedman’s MD. Because of the characteristic structure of a special-field terminology and the organizational principle of such a dictionary, there are lengthy main entries (sometimes extending over multiple pages) with a very long list of subentries from which to choose an appropriate one. As changes introduced in the 28th ed. for ease of reference, the boundaries of such main entries are clearly indicated: the beginning is marked by a headword in white capitals against the background of a column-wide green banner, and the ending by a thick green line (see Appendix A). Entries of “high-profile” words are provided in light-blue boxes21.
ALPHABETIZATION

Solid and hyphenated compounds are entered as main headwords, and spaced compounds are as subentries. Location of the latter can be confusing. For example, all the following compound terms are entered under tumor: carcinoid tumor, giant cell tumor of bone, and Wilms tumor (p. xlii). As a rule, multiple-word chemical and drug terms are entered at the first element. However, if a term includes a general word indicating ‘kind’ or ‘type,’ the term is located at the word (ibid.): e.g., acute abscess and abscess cavity are found under abscess and cavity, respectively. To save space, acute abscess is listed as acute a., with the headword item “agent” abbreviated to “a.” (see Appendix A).

In alphabetization of main entries, the following are ignored: prepositions, conjunctions, articles, apostrophes of possessives, spaces, punctuations, Greek letters (e.g., α, β, γ), numbers, configurational characters (e.g., D-, +, -), and italicized forms (e.g., p-, N-, cis-) (p. xliii). However, prepositional phrases (especially Latin: e.g., in vitro) are found at their alphabetical places. The same applies to spelled-out Greek letters and configurational forms: e.g., α-naphthylthiourea is listed after naphthyl. Listing of subentries follows the same principles as those of main entries, except that the main entry item is ignored in alphabetization.

MICROSTRUCTURE

A main entry is structured as follows. The headword is provided in bold. The pronunciation appears in parentheses. Definition follows. Multiple definitions are numbered, but “their numerical sequence does not necessarily indicate importance or preference” (p. xliv). Etymology in square brackets comes before the list of subentries.

CROSS-REFERENCES

There are numerous cross-references (typed in light blue) in Stedman’s MD. Due to space constraints and to optimize information presentation, some entries are provided with only synonyms that cross-refer the user to the defined entry. To save space, the same rules of abbreviation as subentries (Note 22) are applied to cross-references. When the cross-reference points to another subentry within the same main entry, the headword item is represented by the initial letter: apical a. SYN periapical a.

When the cross-reference is made to an item outside the same main entry, the headword item under which the term is located is italicized: Munro a. … SYN Munro macroabscess.

In addition to “SYN,” there are other cross-referencing indicators: SEE, SEE ALSO, and Cf. (in the decreasing order of direct relationship, xlv).25

SPECIAL GUIDANCE ON LOCATION OF MULTIPLE-WORD TERMS

In Stedman’s MD, consultation of multiple-word terms can be a complicated and time-consuming process. For successful consultation, users need to familiarize themselves with the above-mentioned specifics of dictionary structure and conventions and strictly follow the rules they entail. In addition, the dictionary offers the following general advice:
Tips on Finding Multiple-Word Terms

- Look at the alphabetical location of the specific words comprising the term.
- Look under another main entry that is similar to the term you are looking for.
- Look at cross-references.

**To find** | **Look under**
---|---
a surgical procedure | operation, technique, method
a disease | syndrome (p. xli)

**USE OF ELECTRONIC VERSIONS**

**ACCESS TO MEDICAL RESOURCES**

In Casio’s XD-Y5900MED, there are two ways to access the works on medicine: the dictionary selection buttons (except for *Medical English Conversation*) or the menu. There are seven dictionary selection buttons above the keyboard. Four of them are dedicated to medical resources. Each button is assigned two works. The medical resources are paired as follows (from left to right): *Nanzando MD and E-J D for the General Reader* (this is not a medical dictionary, though), *Stedman’s MD* and *Stedman’s E-J MD*, *Medical E-J D* and *Dictionary of Practical Abbreviations in Medicine*, and *Today’s Therapeutic Agents* and *Today’s Clinical Examinations*. One press of a button shows the first of the pair and another shows the second. As the other option, a press of the menu button shows categories. A touch upon “medicine” brings the icons (cover photos) of all eight medical resources onto the screen. To use the reference work, simply touch an icon.

**FIGURE 1. XD-Y5900MED with Stedman’s MD Shown**

**ACCESS STRUCTURE**
Stedman’s MD allows the following four references from the default screen: 1) headword search, 2) spell checker, 3) compound search, and 4) appendix search. The organization of information is discussed, dealing mainly with the first.

1) **Headword search:** To the entered spelling, 10 headwords and multi-word subheads are shown in alphabetical order with the exact or nearest match at the top in the left-hand column. With a compound term, the element making a main entry is indicated in square brackets. On the right-hand side, the preview of the entry of the first item in the left-hand list is shown. By highlighting an item in the list, the user can show the preview of the entry. They press the “translate/execute” button below the keyboards to go to the entry.

![Figure 2. Headword Search in Stedman’s MD in XD-Y5900MED](image)

**MAIN ENTRY**

A main entry (e.g., **abscess** in Appendix A) is shown in the same way as in the print version, except that subentries are listed without definitions or synonyms. Each subentry term is given in red type, preceded by an arrow, without the headword item being abbreviated to the initial letter. To show the entry, the user touches the term, or presses the “jump” function key to highlight a subhead then the “translate/execute” key.

![Figure 3. abscess in Stedman’s MD in XD-Y5900MED](image)
A subentry is shown in the same manner as in the print edition. The exception is that synonyms or cross-references are not abbreviated or typographically discriminated according to the location of the entry within or outside the main entry being consulted (see Munro abscess in Fig. 5, cf. CROSS-REFERENCES)\(^26\).

Without special conventions or typological discrimination, there is no knowing that periapical abscess is given as a synonym to apical abscess, both being listed under the main entry abscess and that Munro macroabscess is given as a synonym to Munro abscess, the former being entered under macroabscess but the latter under abscess. Importantly, however, this type of knowledge does not constitute a prerequisite for consultation of an electronic dictionary, nor are the rules of alphabetization (ALPHABETIZATION) or Stedman’s MD’s “Tips on Finding Multiple-Word Terms” (p. xli).

The transfer from a cross-reference to the suggested entry is much easier in Stedman’s E-J MD than in its original English edition. With Stedman’s E-J MD, all that one has to do is to touch the cross-referencing synonym, or press the “jump” button to highlight the synonym and push the “translate/execute” button. In contrast, the user has to go through a rather complex process to show the cross-referred entry in Stedman’s MD. For example, to go from apical abscess to periapical abscess (given as a synonym), the user has to follow the following steps:
1 Press the “jump” button to highlight the synonym. However, the highlight can only be made to one word; the whole compound cannot be covered. Therefore, try highlighting periapical\textsuperscript{2}.

2 The list of relevant dictionaries (whose headwords are in English or include the language) is shown with periapical or approximate headwords. Scroll the dictionary list by pressing the rightward scroll button. Stedman’s MD appears as the seventh dictionary with [abscess] periapical abscess and periapical as candidate entries\textsuperscript{28}.

FIGURE 6. Result of the jump search from periapical in XD-Y5900MED

3 [abscess] periapical abscess is already highlighted and the preview of the entry is shown. Press the “translate/execute” button to show the entry in full.

As this example shows, Stedman’s E-J MD is easier to navigate than the original dictionary. This is probably because Stedman’s E-J MD has been improved for better adaption in the HHED since its first inclusion in 2004. On the other hand, Stedman’s MD was incorporated in an HHED in 2016 for the first time. There is room for improvement in terms of navigability. The touch-to-show-entry function is available for subentries listed under main entries in Stedman’s MD. This function should simply be extended to synonyms and cross-references, to save the user this multi-step procedure to reach cross-referred entries.

2) Spell checker: to the entered incorrect spelling, candidates are shown.

3) Compound search: main and sub-entries of compounds including the entered keyword are listed alphabetically with the keyword in the middle.

4) Appendix search: This function gives the user access to the plates included in the middle matter of the print dictionary. The search begins by choosing one out of the 64 headings from – “Human anatomy” to “Gerontology” – listed on the left-hand side of the screen. Then choose a subhead and press a sign to show the illustration. Too large to fit in the screen, pictures are scrollable. It is handy to be able to check the dictionary definition of the caption indicating a part of the picture in the pop-up window by touching on the caption\textsuperscript{29}. The window can be expanded to full screen by the press of a button coming up on the left-hand side.
Stedman’s E-J MD allows the following searches from the default screen: 1) headword search, 2) spell checker, 3) compound search, and 4) Japanese search. While the last one based on the Japanese-English index is a unique search method, the first three are almost the same as those in Stedman’s MD. The only differences are that in the headword search, a list of 15 items (rather than 10) is shown and that headwords and multi-word subheads are shown in alphabetical order, indiscriminately.

Japanese search: to the entered Japanese, 15 Japanese terms from the 9,000-term Japanese-English index are shown in the Japanese alphabetical order, with the exact or nearest match at the top.

POINTERS TO THE FUTURE DEVELOPMENTS

Now that Stedman’s MD and its Japanese edition are packaged together in an HHED, the transfer between the two should be made much easier. Since the two dictionaries are assigned to the same dictionary selection button (ACCESS TO MEDICAL RESOURCES), one press of the button should enable a switch from one to the other. However, this is only possible
from the screen with the search box displayed. For example, to switch to Stedman’s E-J MD from consultation of Stedman’s MD (the screen showing an entry from the dictionary), the user has to press the back button once or twice to get the search box back on, and then to push the dictionary selection button. This is awkward. In addition, the transfer between the two dictionaries should be improved while using the spell checker and the compound search. Presently, the user has to start each search from scratch by keying in a search term.

It is very convenient that the Japanese-English index of Stedman’s E-J MD is integrated in the electronic version and is usable from the default screen of the medical dictionary. This is an electronically enhanced search method, but there is more that could be done to this sort of index. In the print version, the index is 432 pages long with 9,000 Japanese terms. In the electronic version, the index based on careful selection can be expanded to include many more terms to improve consultation efficiency. Furthermore, the index can even be eliminated, if the full text of Stedman’s E-J MD is electronically adapted so as to be searchable by any Japanese word or word combination. This is technically possible.

Further to the suggestions made in the preceding paragraphs, another practical innovation would be amalgamating Stedman’s MD and Stedman’s E-J MD in the medium of HHED. To the best of my knowledge, XD-Y5900MED is the first HHED to include both a source dictionary and its translated version. However, these two dictionaries are incorporated as independent works. If the two dictionaries are merged, so as to be manipulated for various linguistic analyses and for learning purposes, it would add much value to and open up new dimensions in the use of an HHED.

Aside from possible contractual complexities involving publishers and the manufacturer, we would like to see Stedman’s MD and Stedman’s E-J MD as parallel texts electronically combined for analyses and display to maximize the potential of the combined use of the source dictionary/translated dictionary pair for both Japanese and English-speaking users from either language.

If the two dictionaries are merged, the concept of transfer between them disappears. The HHED can be devised to automatically show the search results of both dictionaries in response to the consultation of either. The results can be shown in the split screen with Stedman’s MD in the upper half and with Stedman’s E-J MD in the bottom, or the other way round, according to the user’s choice. Or, English and Japanese components are juxtaposed in each entry, so that the user can easily compare the definitions in both languages.

Here is another way of making full use of the wealth of information offered by the original and translated dictionaries. If the whole text of either dictionary can be searched on the basis of words and word combinations in English and Japanese, it will increase the potential of exhaustive search. In particular, a search for collocations will prove to be effective. If the two dictionary texts are subjected to collocation search in English and/or Japanese, it can extract important collocations specific to medical English and Japanese – and with their translations in the other language. It will be handy to be able to check the meaning of a collocation against the translation of the collocation in the other language. The collocation search will provide invaluable information for Japanese and English-speaking students of medicine, linguists, and lexicographers.

CONCLUSION

Several factors are involved in determining the true value of a specialized HHED. The intrinsic characteristics of the HHED should be weighed against the nature of the subject field, specific user needs, and practical uses to which the device is put. The medical HHED
bundled with the subject field and other reference works brings a number of benefits and saves the user a considerable time and trouble of having to consult multiple dictionaries in different media one at a time. The user is also freed from the requirement to (remember and) follow the organizational conventions and rules associated with the use of print dictionaries. In terms of up-to-datedness of information, however, the HHED is greatly disadvantaged because the product includes published print dictionaries. It may not be cost-effective to purchase a prohibitively expensive medical HHED every year for updated information. On the other hand, it puts Internet-based reference works at a great advantage to keep up with the expanding terminologies of medicine and related sciences, making modifications as needed. It is understandable that students are opting for up-to-the-minute information on the Internet through mobile devices.

It would be an interesting new development if the manufacturer could design and develop original, HHED-compatible resources from scratch, as Tono (2009: 65) suggests. However, it is unlikely given the present market trends. More realistic is for the manufacturer(s) to improve what they already have available and to fully capitalize on the inherent strengths of the HHED: to make use of existing materials for better exploitation. Electronic media has opened up new and unanticipated avenues of dictionary use. Included in the HHED, the boundaries between dictionaries have been blurred. There are functions that consult several relevant dictionaries simultaneously. A new breakthrough in the development of HHEDs may lie in adapting and integrating a dictionary and its translated version organically for the use in a HHED as if the two works were one single bilingual, bidirectional resource to be manipulated flexibly for reference and learning. This is in line with making the most of the inherent strengths of the HHED, which is in search of a competitive edge over smart devices with an Internet connection. What holds for English/Japanese medical dictionaries is also applicable to other-genre dictionaries and to other language pairs, triplets, and even more.

END NOTES

1 I would like to express my gratitude to Professor Leonid Yoffe and Mr. Satoru Kikuchi for their help with the final draft of this paper. I would also like to thank Brain Corporation for the lease of a medical hand-held electronic dictionary, XD-Y5900MED.
2 According to Oshima (2016), 58.3% and 76.2% of Japanese senior high school and university students, respectively, own an HHED.
3 In Sekiyama (2016a and b). “HUED” stands for “hand-held unabridged electronic dictionary,” which is a hand-held device that incorporates the cover-to-cover textual information carried by a print dictionary. In this paper, “HHED” is used.
5 Tono (2009, p. 34) deals with other hand-held devices than those including the full textual content of works. He traces the origin of the pocket electronic dictionary down to Sharp’s IQ-3000 (2009).
6 Sekiyama (2010) summarizes the development of the example sentence search function as follows:

SII’s SR8000 (1999): First example search, runs a search for the examples in the relevant included dictionaries on the basis of the entered keywords
SII’s SR-E10000 (2005): Wordbank (5 million words from Bank of English), example search with word order designated
SII’s SR-G10000 (2006): searches examples in English-Japanese dictionaries on the basis of Japanese words (not of English words), results displayed with the key word in the middle
SII’s SR-G10001 (2009): attribute-specific search with Oxford Sentence Dictionary (OSD, one million examples), can specify: mode (spoken, written/edit/unedited), dialects (American, British, Canadian, etc.), and domains (fiction, law, medicine, news, etc.) (Sekiyama [2010] as quoted in Yamada [2013, p. 161])

OSD exists only in an electronic format. It is a collection of one million examples from Oxford English Corpus (two billion words). The examples were collected after 2000 to provide examples
for the unillustrated entries in Oxford Dictionary of English (ODE) (Sekiya 2010). In Casio’s recent HHEDs, the examples from ODE have been integrated into the appropriate senses of ODE.

7 NHK’s (Japan Broadcasting Corporation) programs are included: as a radio program, the previous year’s edition of Radio English Conversation, for example; as TV programs, animated movie series Little Charo (a puppy’s adventures) in 50 instalments each.

8 The same manufacturer’s SR-E9000 (2005) was intended for broader professional audiences: not only engineers but also business people and translation specialists. A large terminological database, 180-mango Taiyaku Dai-jiten Ei-wa Wa-ei was incorporated for the first time in an HHED. Incidentally, there are other large databases that made their way into HHEDs than Wordbank, OSD, and “1.8 Million-word Database of English-Japanese and Japanese-English Technical Terms” (Yamada 2013, pp. 159-160):

One Million-word Comprehensive Database of Technical Terminology. CJK Dictionary Institute. (“A comprehensive Japanese-English bilingual, bidirectional database of over 1,000,000 technical terms covering a broad spectrum of fields ranging from computer science to biotechnology,” in Casio’s XD-SP9500 [2008], http://www.cjk.org/cjk/samples/japterm.htm)

Eijiro. 2010. 5th ed. Alc. (1.7 million-word bilingual English-Japanese database, in Canon’s V330 [2010])

9 There is a free 19-page HHED user guide.

10 Since 2014, some of Casio’s HHEDs have been equipped with a recording function. Those with Hatsuon Toreningu [Pronunciation Training] allow the user to say designated English words into the built-in microphone. The pronunciation is recorded and analyzed for the initial vowel or consonant of a word, and is evaluated in numerical terms (out of 100) with feedback.

11 As a new development, the 2017 version of English Training Gym offers “Tra[ining] Gym Plan,” which appears at the top of the default screen. The Plan suggests study menus for various purposes and different proficiency levels (e.g., Review of senior high English [listening]) with relevant materials, indicating the required time. The Plan is supervised by Professor Osamu Takeuchi, expert in English language educational technology.

12 Due to memory limitations, HHEDs in those days only stored the textual information of dictionaries.

13 This work is only available in electronic form.

14 In the medical HHEDs market, SII was once dominant but eventually lost out to Casio. Overall, sales of HHEDs peaked in 2004 (unit sales) and in 2007 (revenue) (Nakamura 2009: 23). In the shrinking market, all the other manufacturers lost market share to the sole leader Casio. Here is a comparison of market share of 2007 and 2016:

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>2007 (BNC Ranking)</th>
<th>2016 (Kakaku.com)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Casio</td>
<td>50.7%</td>
<td>82.36%</td>
</tr>
<tr>
<td>Sharp</td>
<td>31.5</td>
<td>16.15</td>
</tr>
<tr>
<td>Canon</td>
<td>9.4</td>
<td>0.69</td>
</tr>
<tr>
<td>SII</td>
<td>8.2</td>
<td>0.36</td>
</tr>
<tr>
<td>Others</td>
<td>0.3 (King Jim 0.28)</td>
<td></td>
</tr>
</tbody>
</table>

Sony pulled out in 2006, and so did SII in 2015. Oshima (2016) showed that Casio prevailed and persisted, nevertheless, suffering only slight declines in unit sales in recent years. He attributes his company’s strength to a strategic focus on the products for senior high school students, a segment which generates stable annual sales. On the other hand, SII’s strategies to cater to specialist needs did not prove to be successful, at least in commercial terms. Ironically, however, SII’s withdrawal from the HHED production raised the value of their products, especially among translators, and substantially boosted the demand for them. SII’s electronic dictionaries were put up for online auction for outrageous prices (Sekiya 2016b).
It is not clear what changes and modifications are allowed to be made to a headword.

When a headword is preceded by a blue square with a letter “i” in white (e.g., amebic a. s.v. abscess in Appendix A), it indicates that the entry includes an illustration. This indication is not repeated in Stedman’s MD in HHED or in Stedman E-J MD in both book form and HHED.

In Stedman E-J MD, etymological information is provided after the pronunciation.

The highlight should be applied to two or more words to make the transfer to the exact entry possible.

This function is not available for the pictorial illustrations included in entries in Stedman’s MD or in Stedman’s E-J MD.

It is not clear what changes and modifications are allowed to be made to a published print dictionary by the manufacturer when it is adapted for use in an HHED.

Eiji Jiro (English-Japanese database-cum-dictionary, available in CD-ROM and online) allows the collocation search on the basis of a combination of English and Japanese words as key words (Yamada 2010: 418). If this kind of search can be run on Stedman’s MD and Stedman’s E-J MD, it will mean trawling through the whole texts of both dictionaries for collocations with a larger and finer-mesh net.

The collocation search will help Japanese/English-speaking students in production, reception, and learning of English/Japanese, linguists and lexicographers in identifying collocations and verifying their meanings, and English/Japanese in standardizing description.

Professor Rumi Takahashi (personal communication) and her colleagues at Showa University observe that almost no medical students use HHEDs relying instead on Internet-based resources such as Life Science Dictionary (medicinal dictionary portal: http://www.life-science-dictionary.com/cgi-bin/lstdproj/ ejjookup04.pl) and weblio (dictionary portal: http://ejje.weblio.jp/). Professor Shigeru Mori at the Medical School of Oita University and Dr. Sayaka Sugimoto at the Medical School of Juntendo University (both personal communication) share a similar observation. Professor Mori teaches his students to use such websites as the New England Journal of Medicine (https://www.nejm.org/) to check medical collocations.

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Sekiyama, Kenji. (2010). Keitai Kopusu to shite no Denshi Jisho: Reibun Kansaku kara OSD made. [Hand-held
Electronic Dictionaries as Portable Corpora: From Example Sentence Search to OSD (Oxford Sentence Dictionary)]. The 11th JACET English Lexicography Society Workshop. Toyo University, Tokyo. March 27.


APPENDIX A

STEDMAN’S MEDICAL DICTIONARY. 28TH ED. 2006

ABSCESSES (ab’sēz). Avoid the misspellings abscess and abscess. Avoid the mispronunciation ab’sēz-ēz of the plural of this word. 1. A circumscribed collection of purulent exudate frequently associated with swelling and other signs of inflammation. 2. A cavity formed by liquefactive necrosis within solid tissue. [L. abscessus, a going away]

Acute a., a recently formed a. with little or no fibrosis in the wall of the cavity. SYN hot a.

Alveolar a., an a. situated within the alveolar process of the jaw, most often caused by extension of infection from an adjacent nonvital tooth. See this page. SYN dental a., dentoalveolar a., root a.

Abscess

Crypt a.’s, a.’s in crypts of Lieberkühn of the large intestinal mucosa; a characteristic feature of ulcerative colitis.

dental a., dentoalveolar a., SYN alveolar a.

diffuse a., a collection of pus not circumscribed by a well-defined capsule.

Douglas a. (dōg’lēz’), suppurative in Douglas pouch.

dry a., the remains of an a. after the pus is absorbed.

Dubois a.’s (dō-bō’z), small cysts of the thymus containing polymorphonuclear leukocytes but lined by squamous epithelium, reported in congenital syphilis but also found in the absence of syphilis. SYN Dubois disease, thymic a.'s.

Embolic a., an a. arising distal to the point of arrest of a septic embolus.

Epidermal a., a lesion found between the cranium (skull) and dura mater; often due to infection in mastoid and frontal sinuses, to trauma, and, in the context of emergency medicine, to illicit injecting drug use.

Fecal a., SYN fecal a.

Follicular a., an a. in a hair, follicul in, or other follicle.

Gas a., an a. containing gas. Frequently caused by gas-forming organisms such as Enterobacter aerogenes or Escherichia coli.

Gingival a., an a. confined to the gingival soft tissue. SYN gum boil, parulis.

Gravitation a., SYN perforating a.

Gummatous a., an a. due to the softening and breaking down of a gumma, especially in bone.

Hematogenous a., an a. caused by blood-borne organisms.

Hot a., SYN acute a.

Hypostatic a., SYN perforating a.

Ischiorectal a., an a. involving the ischiorectal fossa.

Lateral alveolar a., an alveolar a. located along the lateral root surface of a tooth. SYN pericemental a.

Lateral periodontal a., an a. that forms at the depth of a periodontal pocket due to multiplication of pyogenic microorganisms or the presence of foreign material.

Lung a. (ling’), an a. in the lung parenchyma, diagnosed as such by cavitation, bronchial communication, and replacement of some air by pus.

Masloid a., an a. due to coalescence of the mastoid air cells in mastoiditis.

Metastatic a., a secondary a. formed, at a distance from the primary focus, as a result of the transport of pyogenic bacteria by the lymph or bloodstream.

Migrating a., SYN perforating a.

Military a., one of a number of minute collections of pus, widely disseminated throughout an area or the whole body.

Munro a. (mōn’rō), SYN Munro microabscess.

Orbital a., a collection of pus often located between the orbital periosteum and the lamina papyracea; frequently an extension of purulent infection of the paranasal sinuses, usually the ethmoids.

Otitic a., a brain a., usually involving the temporal lobe or cerebellar hemisphere, secondary to suppuration of the middle ear.

Palatal a., (1) a lateral periodontal a. associated with the lingual surface of a maxillary tooth; (2) an alveolar a. that has eroded the cortical plate, allowing extension into the palatal soft tissues.

Pancreatic a., an a. in the pancreatic or periampullary area usually related to pancreatitis.

Parafrenal a., an a. that occurs on either side of the frenum of the penis.

Parametric a., Parametritic a., an a. in the connective tissue of the broad ligament of the uterus.

Paraphreric a., an a. in the region of the kidney, outside the Gerota (renal) fascia.

Parotid a., suppuration in the parotid gland; an often rapidly progressing complication of parotitis. See page B22.

Pauvert a. (pōvərt’), SYN Pauvert microabscess.

Pelvic a., an a. in the pelvic peritoneal cavity, developing as a complication of diffuse peritonitis or of localized peritonitis associated with abdominal or pelvic inflammatory disease, such as
salpingitis; the pus frequently collects in the rectovesical or recto-uterine pouch.

perforating a., an a. that breaks down tissue barriers to enter adjacent areas. SYN gravitational, hypostatic a., migrating a., wandering a.

periapical a., an alveolar a. localized around the apex of a tooth root. SYN apical a., apical periodontal a.

periapendicular a., SYN appendicular a.

periarticular a., an a. surrounding a joint, but not necessarily involving it.

periarticular a., SYN appendicular a.

periappendicular a., SYN appendicular a.

periostial a., SYN lateral alveolar a.

pericoronatal a., an a. developing in the inflamed dental follicular tissue overlaying the crown of a partially erupted tooth.

periappendicular a., an a. within the Gerota fascia but outside the renal capsule.

periosteal a., an alveolar a. or a lateral periodontal a.

periosteal a., an a. in connective tissue adjacent to the rectum or anus. See this page.

peritominal a., extension of tonsillar infection beyond the tonsillar capsule with abscess formation between the capsule and the musculature of the tonsillar fossa.

perirenal a., an a. surrounding the ureter.

perirenal a., an a. involving the tissues around the urethra, particularly the corpus spongiosum.

phlegmonous a., circumscribed suppuration characterized by intense surrounding inflammatory reaction that produces induration and thickening of the affected area.

Pott a. (p01), tuberculous a. of the spine.

prominatory a., an a. in the subcutaneous tissue covering the mammary gland.

psoras a., an a., usually tuberculous, originating in tuberculous spondylitis and extending through the iliospinal muscle to the inguinal region.

pulp a., an a. involving the soft tissue within the pulp chamber of a tooth, usually a sequel of caries or less frequently of trauma.

pyemic a., a hematogenous a. resulting from pyemia, septicemia, or bacteremia. SYN septicemic a.

radicular a., alveolar a., an a. around a tooth root.

residual a., an a. recurring at the site of a former a.; results from persistence of microbes and pus.

retrolubar a., an a. posterior to the globe of the eye.

retrocecal a., an a. located posterior to the cecum, usually resulting from perforation of a retrocecal appendix.

retropharyngeal a., an a. arising, usually, in retropharyngeal lymph nodes, most commonly in infants.

ring a., an acute purulent inflammation of the corneal periphery in which a necrotic area is surrounded by an anular girdle of leukocytic infiltration.

root a., SYN alveolar a.

satellite a., an a. closely associated with a primary a.
APPENDIX B

**STEDMAN'S ENGLISH-JAPANESE MEDICAL DICTIONARY.** 6TH ED. 2008

abortion

a-bor-tion (Ab) (ak-bör’shün). f. Abortion of a fetus; the premature separation of the uterus from the remainder of the body of a woman. (A term in obstetrics and gynecology); also the process in normal pregnancy which results in the release of the embryo into the uterus. This term is used in obstetrics and gynecology.

ab-scess

a-b-sec (Ab-see’s). n. pus collection or abscess formation in the skin or in any part of the body; especially a deep sinus of the gum or skin.

a-bre-hams (ak-brä’ims). n. a disease of the sex organs caused by an imperfectly developed ovary or ovary; also an imperfectly developed ovary.

a-b-ra-sion (ak-bra’shün). f. a scraping off of the surface of a tissue or organ; also a tearing of the skin or mucous membrane.

a-bre-val (ak-brel’val). a. having a hard surface; also a hard surface.

a-brasive (ak-bra’ziv). a. capable of scratching or cutting; also a substance capable of scratching or cutting.

a-b-road (ak-bre’fund). adj. far removed from home; also far removed from home.

a-broad-ward (ak-bre’fund-ward). n. a journey or a passage from one place to another; also a journey or a passage from one place to another.

a-broad-ward-ward (ak-bre’fund-ward-ward). n. a journey or a passage from one place to another; also a journey or a passage from one place to another.

a-broad-ward (ak-bre’fund). n. a journey or a passage from one place to another; also a journey or a passage from one place to another.

a-bre-val (ak-brä’val). a. a condition of the sex organs caused by an imperfectly developed ovary or ovary; also an imperfectly developed ovary.

a-bre-val (ak-brä’val). a. having a hard surface; also a hard surface.

a-broad-ward (ak-bre’fund). adj. far removed from home; also far removed from home.

a-bre-val (ak-brä’val). a. a condition of the sex organs caused by an imperfectly developed ovary or ovary; also an imperfectly developed ovary.

a-bre-val (ak-brä’val). a. having a hard surface; also a hard surface.

a-bre-val (ak-brä’val). a. a condition of the sex organs caused by an imperfectly developed ovary or ovary; also an imperfectly developed ovary.

a-bre-val (ak-brä’val). a. having a hard surface; also a hard surface.