Analysis of Misheard Phrases in Nursing Dialogue

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Abstract

We are now collecting, transcribing and analyzing conversation data in medical and nursing facilities. This is part of nursing assistance research being conducted based on ubiquitous computing technologies. In this paper, we focus on communication error analysis. We analyzed 30 hours and 45 minutes of transcribed voice data collected in a hospital. Incorrectly transcribed phrases are analyzed to find features of incorrect transcription.

1. Introduction

In order to reduce accidents and incidents in nursing and to improve the quality and effectiveness of treatment, it is necessary to observe nursing activities and situations and to understand their actual circumstances.

Nanbu et al. [1] pointed out that "Without any communication between various types of staff members, no medical practice can be completed. In addition, ways of information transmission and sharing have close relationship between accidents and incidents. Therefore, they can be important keys to keep safety in medical situations." A medical treatment evaluation section in the Ministry of Health, Labor and Welfare has collected examples of accidents and incidents from many hospitals in Japan and selected significant examples to upload to their Web site (http://www.hiyari-hatto.jp/). In addition, they concluded that:

1) It is not easy to propose effective strategies to solve problems in communication among staff members in hospitals, even if we collected a large amount of examples from many hospitals in Japan for analysis.
2) In order to fully understand accident examples from the viewpoint of communication among staff members in hospitals, it is necessary to comprehend actual communication situations in hospitals. If we conducted such analyses, it would be possible to develop effective strategies for staff members in hospitals for preventing accidents and incidents. Such strategies could be established not for individual events but for general events. In addition, communication among staff members in hospitals would be improved, thus helping to maintain safe medical practices.

Kohno[2] pointed out that "In medical places, for information communication media, they use human communication media (e.g. oral communication). Consequently, due to less reliable (forgettable and changeable) human memories and relationships, human errors easily occur."

We analyzed 221 examples uploaded to the accident and incident Web site (September 2005). We could collect 61 examples (22.6%) involving "conference," "communication," "intention transfer," "handover," and "oral order." From the results, we concluded that communication errors could cause accidents and incidents that are classified as human errors. In this paper, therefore, we analyze nurses' conversation data collected by a wearable recording system.

2. Methods

2.1. Voice data collection

Collection time: From 13 Dec. 2004 to 18 Dec. 2004. In detail, voice data sets (30 hours and 45 minutes) were collected over those 5 days. They include voice data sets spoken during all of the nurses' duty time (three shifts).

Subjects: Fourteen nurses who have been working from 1 year to 11 years.

Venues: The Ophthalmology Department, the Otorhinolaryngology Department, and the Internal Medicine Department of a certain hospital.

Procedure: Nurses wore the wearable recording devices shown in Fig. 1. Voice data during "handover," "oral order,'' and "conference" were collected.

Ethical considerations: Objectives of the experiment were explained to the subjects. The experiment was conducted with the assistance of those who understood and agreed with the objectives. In addition, we guaranteed that individual information would not become open to the public.

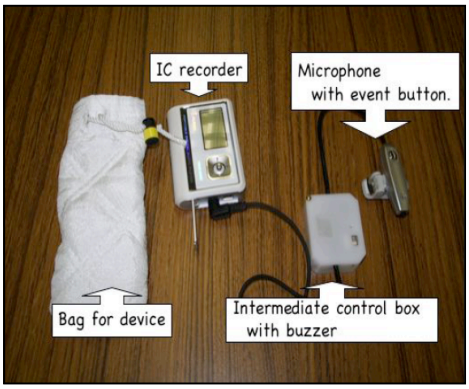

Figure 1. Voice recorder

2.2. Voice data collection

- Sets of collected voice data were transcribed by expert transcribers. Then text data sets (12,764 lines) containing unrecognized words were obtained.
- The transcribed text sets were checked by two nurses who had worked more than three years. In addition, the transcribed text sets were checked again by two other nurses who had worked more than ten years. A total of 952 phrases (358 distinct types) were extracted as incorrectly transcribed words.
- The 358 extracted phrases were categorized as follows:
  1) Phrases including numerical values
  2) Phrases including alphabetic characters
  3) Phrases including katakana characters
  4) Others
- From the 358 phrases, 319 words excluding numerical values and units were extracted as abbreviations and synthesized words. These were compared with words included in Bunrui Goihyo[3], a reference that includes 100,000 everyday words and 200,000 terminologies for medical and nursing science collected for research (nursing terminology set).

3. Results

3.1. Analysis of incorrectly transcribed phrases according to forms of characters

As shown above, 358 phrases were incorrectly transcribed. Among them, 16 phrases included numerical values, and in 9 of these the numerical values could not be correctly transcribed (e.g. 眼圧 14 → 眼圧 54). Seventeen phrases included alphabetical words, ten of which were transcribed in the form of alphabetic characters. Among them, only three alphabetical phrases were correctly transcribed. Four phrases that should have been represented in alphabetical words were transcribed in katakana (IVH→ アデチ). For one phrase, Chinese characters were used instead of alphabetical characters (A1C → え一足). Two phrases could not be fully transcribed (HCV → *ブ).

Table 1. Incorrectly recognized words including numerical values.

Correct words	Incorrect words
72 の (nanaju ni no)	77 (nanaju nana)
眼圧が 14 (Gan-ats ga ju yon)	眼圧 54 (Gan-atsu goju yon)
14 時 (ju-yo ji)	治療時 (Chiryo ji)
2, 4 分 2 (ni, yon bun ni)	リーヨンブンリ (ri-yon bunri)
50 ミリ 2 アン (goju miri ni an)	50 メニア (goju menia)
1 万円 (ichi man en)	1 枚 (ichi mai)
1 包 (ippou)	1 本 (ippon)
2 直帯 (ni chyokutai)	2 直隊 (ni chyokutai)
4 検 (yon ken)	ヨンケン(4 件？) (yon ken)
夕R6 (UR roku)	ユーアール(UR)6 (UR roku)

Table 2. Incorrectly recognized words including alphabetic characters.

Correct words	Incorrect words
CPR 前 (CPR zen)	CPR 全 (CPR zen)
CS 入院 (CS nyu-in)	CS にー (CS nii-)
CT 下の肺生検 (CT ka no hai seiken)	CT から肺**セウキョウ** (CT kara hai seikyou)
DM	AM
PEA	PA
SMBG	SMVG
SOAP	SOP
BMI	DMI
E3 (E san)	**インサン** (in san)
IVH	**アデチ** (a de chi)
MRSA	**エマーリセー** (ema- rise-)
V line	**ドエライン** (do erain)
A1C	え一足 (e- ashi)
HCV	**＊ブ** (….bu)

Incorrect transcriptions would occur due to low-quality recordings. However, even if we could obtain the best quality recorded sound, incorrect transcriptions might still occur. If a transcriber does not know specialized words or does not have background knowledge in the application field, incorrect transcriptions tend to occur. Furthermore, in the case of “眼圧が 14 → 眼圧 54”, “ga ju” was heard as “go ju.”

This type of incorrect transcription cannot be avoided even if a transcriber has sufficient knowledge in the application field, since it is sometimes difficult to distinguish “a” from “o” due to similar pronunciation.

Table 3. Incorrectly recognized words including katakana characters.

Correct words	Incorrect words
モーラスパップ	もう、ラスカップ
(mo-rasu pappu)	(mou rasukappu)
ラキソベロン	だけとベロン
(Rakisoberon)	(dakedo beron)
ヘアバスとベベ	部屋バストベで
(hair bath to bebe)	(heya basutobe de)
アップしている	安定している
(appu shiteiru)	(antei shiteiru)
タンポン抜去	担当バック
(tanpon bakkyo)	(tantou back)
ワーファリン	バファリン
(Warfarin)	(Bufferin)

On the other hand, in the case of “V line → ドエライン”, if a transcriber had sufficient knowledge in the application field, such incorrect transcriptions could be avoided.

Considering the case of “2, 4 分 2 → リーヨンブンリ’’, the recordings themselves do not seem acceptable. This is because “n” is heard as “r”. Of course, in actual situations, “n” is sometimes heard as “r” if we do not have sufficient knowledge. Therefore, we can easily understand that such incorrect transcriptions can occur if a transcriber does not know the application field.

Among incorrectly transcribed phrases, 111 phrases include katakana. Forty-one of them should be medicine names, but transcribers could not correctly recognize them. On the contrary, in some cases, although phrases or words could be correctly recognized as phrases or words (in the same category), their names are different (ワーファリン → バファリン). In this case, a transcriber seemed to recognize it as a more familiar medicine. If he/she has medical knowledge, such an incorrect transcription should have been avoided, since only one medicine should be applied for a particular medical condition.

3.2. Analysis of phrases according to features of included words

Among the 319 phrases that were incorrectly transcribed, 89 words are included in Bunrui Goihyo and can be regarded as everyday words. Since they are everyday words, perhaps due to missing context, transcribers seem to make mistakes. In addition, pronunciations between correct words and incorrect words are similar. Thus, this type of incorrect transcription would easily occur (Table 4).

Table 4. Incorrectly recognized words regarded as everyday words.

Correct words	Incorrect words
転倒	点灯？
(tentou)	(tentou)
床上	症状
(syoujyou)	(syoujyou)
予約	与薬
(yoyaku)	(yoyaku)
既往	今日
(kiou)	(kyou)
転科	検査
(tenka)	(kensa)
前後に	全部に
(zengo ni)	(zenbu ni)
次回	時間
(jikai)	(kikan)
病名	両目
(byoumei)	(ryoume)
気切部	気節部
(kisetsu bu)	(kisetsu bu)
腰痛	尿痛
(youtsu)	(nyoutsu)
絶食	自食
(zessyoku)	(jisyoku)

Table 5. Incorrectly recognized words regarded as nursing terminology.

Correct words	Incorrect words
オペ前	プレゼン
(ope zen)	(pre zen)
ギャッチアップ	キャッチアップ
(Gyacchi up)	(Catch up)
綿球	ネンキュウ
(men kyu-)	(nen kyu-)
輸液	デーキ
(yu e ki)	(de-ki)
眠前	インセン
(min zen)	(in sen)
滲出性	シンシツ性
(shinsyutsu sei)	(shinshitu sei)
血糖	きっと
(kettou)	(kitto)
入室時	入出時
(nyu- shitsu ji)	(nyu-syutsu ji)
蓄尿	蓄膿
(tiku nyou)	(tiku nou)
舌苔	絶対（全体？）
(zettai)	(zentai)
掻痒感	ソウヨカン
(sou you kan)	(sou you kan)
霧視	ムシ（無視？）
(mushi)	(mushi)
保清	補正
(hosei)	(hosei)
床上安静	症状安静
(syoujyou ansei)	(syoujyou ansei)

As for 230 phrases that do not include words in Bunrui Goihyo, 135 phrases included words in the nursing

terminology set. In addition, 53 words were expressed in katakana (Table 5).

Table 6. Incorrectly recognized words including particles.

Correct words	Incorrect words
押して (oshite)	をして (wo shite)
リンコデ (Rinkode)	リンコで (rinko de)
シックデイ (sick day)	シックで (sick de)
切開排膿 (sekkai hainou)	切開ハイの (sekkai hai no)
肝機能障害 (kankinou syo-gai)	カンキの障害 (kanki no shougai)
眼圧が 14 (Gan-atsu ga ju yon)	眼圧 54 (Gan-atsu goju yon)

Other phenomena involve the recognition of part of a word as a particle (押して → をして) and not recognizing particles that should exist (Table 6).

We analyzed 95 phrases that do not include words in the nursing terminology set. Nine words were abbreviations of medicine names, four words were proper nouns, such as the names of companies or products, and 63 words were spoken language (jargon) or abbreviations specialized in nursing activities (Table 7).

Table 7. Incorrectly recognized words.

category	Variety (ratio)
nursing terminology	135 (42.3%)
everyday words	89 (27.9%)
nursing jargon and abbreviation	63 (19.7%)
name of medication	9 (2.8%)
name of vendor or product	4 (1.3%)
others	19 (6.0%)
Incorrectly recognized words	319 (100%)

Table 7 shows the classification of 319 incorrectly transcribed phrases, from which 39 phrases including numerical values and units were removed. Fully 62% of them were categorized as nursing terminology, nursing jargon, and abbreviations. This, we can assume, would occur because people who had never worked as a nurse transcribed the voice data. Furthermore, 19.7% of incorrectly transcribed words were nursing jargon and abbreviations. Therefore, we can suppose that nurses' conversations include many nursing jargons and abbreviations specialized to the particular hospital that are not included in ordinary nursing terminology dictionaries. A nurse who frequently uses phrases including such nursing jargon and abbreviations, even an experienced nurse, might mishear or misunderstand a phrase if he/she has just changed his/her working place.

4. Discussions

The data shown in this paper are included in nursing conversation during actual nursing activities. Therefore, they have the following features:

1) Differently experienced nurses converse together.
2) Sometimes, a conversation includes more than one topic.
3) Nurses converse in noisy environments due to other conversations and their ongoing activities.

It is not easy to separate each topic in a conversation or to distinguish one speaker from the other ones in such non-ideal situations.

In this study, transcriptions were made by transcribers having the following features:

1) Those who could identify topics of conversations and distinguish more than one speaker when only listening to voice data.
2) Those who had neither nursing experience nor knowledge of nursing practices.
3) Those who knew conversations were made by nurses in nurse stations of the otolaryngology department.

However, as they became engaged in the transcription work, the following features could be observed:

1) Their knowledge of nursing practices gradually increased because they carefully listened to nursing conversations.
2) Since they used computers for editing with an automatic kana-to-Chinese character transformation system, their knowledge of words that have the same sound but different meaning gradually increased.

The above development of transcribers might be similar to knowledge acquisition by novice nurses. Therefore, analyses of incorrect transcriptions could help us to understand the tendencies of communication errors by novice nurses. In the following, we briefly discuss such tendencies.

4.1. Description features

In the case of incorrect transcriptions of phrases including numerical values (Table 1), the following errors were observed:

1) Numerical numbers are incorrect.
2) Units are incorrect.

Reasons for (1) could be (a) environmental problems such as noisy situations and (b) insufficient knowledge of the proper range of each value. A reason for (2) could be insufficient knowledge of the units used in nursing practices.

As for incorrect transcriptions of phrases including alphabetic characters (Table 2), in a very few cases, transcribers used Chinese characters. They usually use katakana to express objects. Consequently, they seem to recognize that those objects should be alphabetical abbreviations of objects or concept. Therefore, if they had sufficient knowledge of the abbreviations used in nursing practices, incorrect transcriptions would be reduced.

On the other hand, as for incorrect transcriptions of phrases including katakana, many of them were incorrectly separated (Table 3). Expressions in katakana are frequently used not only for medicine names but also for nursing practice names[4]. In addition, expressions in Katakana have problems such as multiple meanings and expressions [5]. As a result, even if those expressions could be correctly heard and transcribed, several communication errors might occur. In addition, in some cases, transcriptions were influenced by the transcribers' own knowledge. For instance, in Table 3, we can see an example transcribed as "バファリン (Bufferin)" instead of "ワーファリン (Warfarin)". This is because Bufferin is a more famous medicine than Warferin to laypeople, and thus the transcriber incorrectly recognizes the former after deciding the phrase refers to the name of a medicine.

Therefore, in order to reduce communication errors with expressions in katakana used in hospitals, preparation of a terminology list would be effective. In addition, recording communication results in documents might also be effective for later confirmation.

4.2. Specialized and general terminologies

In speech interpretation, we usually use not only grammatical knowledge but also logical, semantical, and contextual implications to reduce ambiguities [6].

Table 4 suggests interesting phenomena on how a normal person identifies rarely heard concepts or objects that have the same or similar pronunciation as general words and thus recognizes them as general words. For instance, 既往 (anamnesis), 転科 (get enrolled in another department), and 床上 (nursery bed soil) can be easily understood if we see them in writing. However, those words are rarely heard in everyday life. Transcribers know that the conversation was done by nurses in the otolaryngology department but guess that the contents do not involve specialized events. As a result, they adopted 今日 (today), 検査 (check), and 症状 (symptom) instead of 既往, 転科, and 床上. Those words are shown as candidates by an automatic kana-to-Chinese character transformation system.

In Japanese, 部 means "part," 痛 means "pain," and 食 means "food." Consequently, we can easily synthesize new word by coupling those words. As for 気切部 (tracheotomy hook), 腰痛 (lumbago), and 絶食 (abrosia), since transcribers guess that those phrases describe part of something, pain in certain parts, and something related to food, they adopt coinages such as 気節部 (*coined terms*), 尿痛 (urodynia), and 自食 (*coined terms*) that cannot be easily transformed (Table 4). 腰痛 (lumbago) and 絶食 (fast) are very common words in Japanese. However, they might think that 腰痛 and 絶食 are too common to use in hospitals, so they seemed to use uncommon words such as 尿痛(urodynia) and 自食. In addition, coinages such as **性 (** feature) and **時 (** time) are also used with certain confidence for transcription (Table 5).

We can observe that they used 与薬 (administration) instead of 予約 (reserve). We assume that transcribers excessively considered the context, i.e. a hospital, and used medical words instead of general words.

Table 5 shows results including nursing terminology. Since, for the transcribers, such words are hardly ever heard, they used katakana to express unfamiliar concepts or objects. Some words such as 保清 (maintenance of cleanness), 床上, and 霧視 (blurred vision) are transcribed as 補正 (correction), 症状, and 無視 (neglect). On the other hand, for 掻痒感 (itching paraesthesia), which is not such an unfamiliar word but uses a difficult Chinese character, they transcribe as ソウヨカン. For 綿球 (swab), they express it as ネンキュウ. The reason for using katakana for 掻痒感 (itching paraesthesia) might be that 掻痒 (pruritus) is not an easy Chinese character. However, we cannot guess why they use ネンキュウ for 綿球 (swab), which does not contain such a difficult Chinese character. If we collect more examples, we might be able to find certain tendencies explaining these phenomena.

Table 6 shows examples of recognizing parts of phrases as particles or failing to recognize parts of phrases. Due to different intonation or accents in particles, parts of phrases might be recognized as particles.

4.3. Limitations

We did not analyze the voice data as they were collected but the text data transcribed at first by expert transcribers who have neither nursing experience nor knowledge. Therefore, 358 incorrectly transcribed phrases should include those that can be easily recognized by a nurse working in a hospital, the nurse who took part in the conversation, and a person who has nursing knowledge. On the contrary, the transcribed data also include phrases that cannot be easily evaluated by even a person who has nursing knowledge, if he/she did not take part in the conversation. In addition, as explained in Section 4, since it is not easy to separate each topic in a conversation and distinguish each speaker,

achieving fully correct transcriptions by nurses who are not expert transcribers is also difficult. Therefore, despite the approach taken, it is difficult to correctly analyze actual nursing conversations in hospitals.

5. Conclusions

Kohno [2] pointed out that the main reasons for communication errors in medical places were as follows: 1) Medical procedure orders are different depending on the medical ward, 2) Abbreviations are different depending on diagnosis and treatment departments, 3) There is no consistency in descriptions for medical matters, 4) There are problems in communication among specialists, 5) Various types of medicine, apparatus, and papers are placed in a small nurse station, and 6) There are incomplete education programs for new employees and incomplete regular medical competency tests for doctors and nurses. Reasons for communication problems among specialists include not only the difference between their experience and knowledge but also the difference between their culture and dialect. In addition, human relationships, such as preference and hierarchy, cause such communication problems.

In this paper, we do not consider such human relationships. Analyses are only based on transcribers' transcriptional features of voice data. However, we could observe that when they could not catch words or phrases for various reasons, they assigned words or phrases to the uncertain sounds based on their personal interpretations. Accordingly, when human factors are added to the communication line, communication errors are likely to occur.

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