

**USE OF ELECTRONIC COMMUNICATION AIDS BY TEMPORARILY NONVOCAL  
PATIENTS IN THE ICU**

by

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# USE OF ELECTRONIC COMMUNICATION AIDS BY TEMPORARILY NONVOCAL PATIENTS IN THE ICU

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**Purpose:** To examine the enactment and progression of assistive and augmentative communication (AAC) device use by nonvocal intensive care unit (ICU) patients during nurse-patient communication over two days.

**Background:** Patient-nurse communication in the ICU is a complex process. Endotracheal intubation or tracheostomy renders patients temporarily unable to speak. ICU nurses occupy a crucial role in facilitating patient communication. The Study of Patient-Nurse Effectiveness with Assisted Communication Strategies (SPEACS) presented basic communication skills training and training in electronic communication devices to nurses in two ICUs to improve communication with nonvocal patients.

**Methods:** We used a descriptive multiple case study design and applied microanalytic communication coding with descriptive analysis using primarily qualitative techniques. A subset of patients ( $n = 9$ ) who were physically (i.e., upper motor) and cognitively intact (RASS = 0, CAM-ICU negative for delirium), throughout all study observations was extracted from the SPEACS sample. The patients were  $> 21$  years old, intubated, scored  $\geq 13$  on the Glasgow Coma Scale, and received a communication plan and electronic AAC device matched to patient ability and preference from a speech language pathologist. For two days directly after the plan was developed, the nurse-patient dyad was videotaped four times (twice daily) during routine care.

The full-length videos (3:25-19:38 minutes) were coded for patient use of natural, low tech AAC, and high tech AAC communication modality; nurse facilitative behaviors/strategies; and patient communication topic.

**Results/Conclusion:** Five patients used the high tech AAC device during observation; 4 patients did not. The Lightwriter device was most common (n=4) and most popular among the high tech AAC users. Nurse facilitative behaviors were observed with 7 dyads; positioning the high tech device appropriately was the most common facilitative behavior for patients who used high tech AAC. The most common topics were comfort care/needs, patient's condition, and greetings/small talk. These were also common topics during high tech AAC communication. All patients used multiple communication modalities and used natural communication modalities most frequently. Although the pattern of AAC use over time differed among the patients, communication rates dropped in most (8/9) cases during session 4. This information regarding how patients use AAC devices may help nurses to better predict their patients' communication needs and to facilitate effective communication.

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## **PREFACE**

I would like to express my appreciation to Dr. Mary Beth Happ and her research team for all of their assistance as I completed this independent research and my Bachelor of Philosophy thesis. I would like to thank Dana DiVirgilio for taking the time to train me in coding and transcription, and for acting as a second rater in interrater reliability checks. I also greatly appreciate the assistance provided by Marci Nilsen and Judith Tate in attaining database access and descriptive statistics via SPSS. I am grateful for the assistance given by Katie Biddle in transcribing the videos used in this study. I would also like to acknowledge the funding received by the Honors College through the Fall Brackenridge Research Fellowship and the original study funding: “Improving Communication with Non-Speaking ICU Patients” National Institute of Child Health and Human Development, grant# 5R01 HD043988, M.Happ.

## 1.0 INTRODUCTION

Many patients in the intensive care unit (ICU) setting are unable to speak due to the placement of an oral endotracheal tube or tracheostomy (breathing tube) for assisted respiration. These patients, however, are able to communicate through the use of augmentative and alternative communication (AAC), which is any form of communication other than oral speech and includes gestures, signing, picture systems, print, and computerized communication (American Speech-Language Hearing Association, 2012). ICU nurses are essential in facilitating patient communication but are not typically provided with the proper tools or training in AAC methods and devices in order to help nonvocal patients communicate most effectively. The third phase of the Study of Patient-Nurse Effectiveness with Assisted Communication Strategies (SPEACS) presented a basic communication skills training course and training in electronic communication devices to ten nurses working in two ICUs to improve communication with patients who were unable to speak.

Thirty patients who were unable to speak due to intubation/mechanical ventilation (3 patients/nurse) received an individual speech language pathologist (SLP) assessment and plan that included the use of electronic communication devices in addition to low-tech communication aids. For two days directly after the plan was developed, the nurse-patient dyad was videotaped four times (morning and afternoon) while routine care was performed in the patient's room. The first three minutes of these videos have previously been transcribed and

coded for quality, frequency, and successfulness of communication. However, the implementation of AAC device use during nurse-patient communication and its use over time has not been examined.

## **1.1 PURPOSE/AIMS**

The purpose of this study was to examine the enactment and progression of AAC device use during nurse-patient communication in the ICU over a 2-day observation period. The following research questions were explored: 1. How do nonvocal intensive care patients use electronic communication devices? 2. How does AAC use change during the two days directly after receiving the device?

## **1.2 MY ROLE IN THIS RESEARCH**

My role in this research study included training to competency in microanalytic coding of AAC usage, selected nurse and patient communication behaviors, and communication topics; literature review of patient communication topics in ICU, tool refinement, and testing; microanalysis of topic of communication acts for full-length videos and of AAC usage and communication behaviors beyond the original 3-minute coding; arranging and computing inter-rater reliability calculations; computing sums and rates of AAC usage, behaviors, and topic categories; constructing tables and graphic data displays. I assumed primary responsibility for data interpretation with guidance from the thesis advisor.

## 2.0 LITERATURE REVIEW

Patients who are acutely ill and treated in the intensive care unit (ICU) setting may be intubated via the mouth or through the neck to assist with breathing. The plastic tube that is placed into the trachea renders the patient unable to communicate through vocal speech. The voicelessness that occurs can be terrifying and frustrating for the patient. It may also cause the patient to not be included in decision-making regarding patient care and treatment (Happ, 2000). The stress and anxiety experienced by the patient while they are unable to speak also affects family members, nurses, and other health care providers (Costello, 2000). Family members of the critically ill patient are often the ones interpreting the patient's nonvocal communication and may express regret and anxiety about the patient's lack of a voice (Happ, 2000). The family may be unable to communicate effectively with their loved one, and the patient may be unable to communicate with family members (Costello, 2000; Broyles, Tate, & Happ, 2012).

Nurses may believe that critically ill patients do not have a need to communicate or that they have effective strategies to assist these patients in communication. Studies show, however, that even experienced nurses have difficulty assisting patients who are unable to speak with communication. This is due to a lack of knowledge and use of augmentative and alternative communication methods and devices (Hemsley et al., 2001; Leathart, 1994). When alternative methods of communication are utilized, the negative effects of voicelessness such as anxiety, fear, and frustration can be lessened (Happ, 2000).

Augmentative and alternative communication (AAC), as described above, is “all forms of communication (other than oral speech) that are used to express thoughts, needs, wants, and ideas” (American Speech-Language Hearing Association, 2012). AAC includes gestures, body language, sign language, writing, picture and letter boards, and electronic communication aids. AAC has been used by physically and mentally disabled patients in a number of settings (Miglietta, Bochicchio, & Scalea, 2004), but is used less frequently with patients who are temporarily unable to speak while in the intensive care unit although the impact may be similar (Hurtig & Downey, 2009). Patients who are intubated are typically limited to communicating through yes/no questions and are not given the opportunity to express their thoughts or feelings further (Happ, 2000; Patak et al, 2009). Working with patients who are unable to speak while in the intensive care unit is different than working with patients who are disabled and chronically unable to speak in that patients in the ICU are acutely ill, and may have short attention spans, fluctuating cognitive and motor capabilities (Dowden, Honsinger, & Beukelman, 1988), and be heavily medicated. These patients need an intervention that requires little new learning, and permits communication to occur almost immediately so that they can express basic needs. AAC methods and devices enable patients who are temporarily unable to speak a way to communicate until their voice returns (Fried-Oken, Howard, & Stewart, 1991).

Nurses in critical care are very important in bridging the communication gap (Patak, Gawlinski, Fung, Doering, & Berg, 2004) and can assist patients in using AAC. In one study, 90% of nurses “felt patients in intensive care need a computer based communication aid; 88% felt a patient’s well-being is affected by their ability to communicate; and 74% felt in their experience patients fail to communicate effectively using mouthing and/or gesture” (MacAulay et al., 2002, p. 229). Many electronic communication aids require a high degree of cognitive

functioning or visual acuity, but some patients are able to use these devices for at least a part of their time in the ICU (Happ, 2001; Happ, Roesch, & Garrett, 2004; Migletta et al., 2004).

Speech generating devices, also known as voice output communication aids (VOCAs), are one type of electronic AAC device. They “produce prerecorded, digitized voice messages (recorded speech) or synthesized speech (computer-generated voice) when the communicator accesses specific locations on a dynamic display screen or membrane keyboard” (Happ et al., 2004, p 93). These devices can include pre-programmed messages that are relevant to the hospital setting, such as “I’m having pain.” Electronic communication aids can also allow patients to spell new messages (Happ et al., 2004).

Barriers to using electronic communication aids in the ICU include “poor device positioning, deterioration or fluctuation in patient condition (motor and/or cognitive function), staff time constraints, staff lack of familiarity with the device, and device complexity (multi-level message screens)” (Happ et al., 2004, p 98) as well as the patient’s energy level and motivation (Happ, 2000). Multidisciplinary team members such as Speech Language Pathologists, who have extensive knowledge in AAC and access to the devices, can assist nurses in using these devices with their patients and decrease the barriers to their use (Happ, 2001; Radtke, Baumann, Garrett, & Happ, 2011). Adults who use AAC while temporarily unable to speak can provide insight about how to better use these devices with patients through feedback and critique of usability features (Fried-Oken et al., 1991; Demers, Weiss-Lambrou, & Ska, 2002). Currently, although there are no electronic AAC devices commercially available that are specifically designed for the adult ICU patient (MacAulay et al., 2002), several devices, feature formats, and platforms are being studied.

Utilizing AAC in the ICU has the potential to improve patient care in a number of ways. It can enhance autonomy, allow for more normal communication, and assist the patient in communicating medical needs. In addition AAC methods and devices can have a positive impact on ventilator weaning, patient affect, and discharge dispositions (Radtke et al., 2011). The use of AAC devices may also affect hospital costs by improving patient care and patient outcomes (e.g., decreased sedation use, less time on mechanical ventilation, reduced length of stay) through effective communication (Miglietta et al., 2004). Clinical research and application of AAC in the ICU setting has not kept pace with the advances made in communication device technology (Happ, 2011) and more research is needed to understand how to best use AAC with this patient population (Happ, Garrett, Roesch, 2003).

## **3.0 METHODS**

### **3.1 SAMPLE/SETTING**

A subset of patients who were physically and cognitively intact throughout all study observation time points was extracted from the SPEACS (parent study) sample. The patients in this study sample were all over the age of 21, unable to speak due to intubation, scored 13 or greater on the Glasgow Coma Scale (Teasdale & Jennett, 1974), had no physical (i.e., upper motor) or cognitive deficits as measured by a Richmond Agitation Sedation Scale (RASS) score of zero indicating ‘calm and cooperative’ (Sessler et al., 2002) and Confusion Assessment Method for the ICU (CAM-ICU) indicating absence of delirium (Ely et al., 2001) at all 4 observation time points during the two-day study period, and received an electronic AAC device matched to patient ability and preference and individual communication plan from an SLP prior to observation. Nine patients (nearly one-third of the parent study sample) met the criteria for inclusion in this study.

This study was conducted in the 32-bed medical intensive care unit (MICU) and 22-bed cardiovascular-thoracic intensive care unit (CTICU) of a large academic medical center (Happ et al., 2011).

## **3.2 DESIGN**

This was a descriptive multiple case study using secondary analysis of data from the SPEACS study (M. Happ, PI, NICHD grant #5R01 HD043988). We received approval from the University of Pittsburgh Institutional Review Board to conduct this secondary analysis (PR0307094). We applied microanalytic communication coding with descriptive analysis using primarily qualitative techniques to analyze the full-length videos of nurse-patient communication in this subsample of 9 awake and alert, intubated ICU patients. These exemplar cases covered a range of ages, gender, illness severity, computer experience, and admitting diagnoses. The full-length videos were reevaluated to identify and quantify AAC device use and to examine how AAC device use changed during the two observation days. Data from study logs, electronic medical record, observation records, and surveys complemented the video observation measures to produce a full description of each case.

## **3.3 DATA COLLECTION**

### **3.3.1 Sample Demographics**

Patient and nurse demographic data were drawn from the SPEACS database. Database information extracted on the patients included age, gender, race, education level, hearing, vision, admitting diagnosis, APACHE III score (Knaus et al., 1991), ICU length of stay, number of days intubated prior to study enrollment, type of intubation, communication difficulty ratings, and prior computer use.

Patient education, hearing and vision, and computer use were obtained by patient or family report. Primary admitting diagnosis, intubation, lengths of stay, and severity of illness scores were obtained by medical record review. Education level was defined as the highest level of education attained – grade school, high school, GED, vocational/technical school, 2-year college (Associate’s level), 4-year college (Bachelor’s level), graduate school (Master’s level), professional school, and graduate school (Doctoral level). Hearing acuity ratings were: impaired, adequate/unimpaired, uses assistive device and not available, or uses assistive device and available. Visual acuity ratings were: impaired, adequate, adequate with correction and corrective lenses available, or adequate with correction and corrective lenses not available.

The patients’ admitting diagnoses were assigned to one of 10 categories: postoperative complication; pulmonary disease/infection; renal or liver failure; neurologic disorder; heme/onc; CHF, cardiomyopathy; sepsis; cardio, thoracic, or vascular surgery; transplant; or other surgery. APACHE (Acute Physiology, Age, Chronic Health Evaluation) III scores were obtained on the study enrollment as a measure of severity of illness. The APACHE III is a tool that measures acute physiological derangements, age, and chronic health disorders of adult intensive care patients. A score is created that predicts the mortality risk of a critically ill adult and the likelihood that the patient will survive to hospital discharge. Scores range from 0 to 299 and the higher the score, the higher the predicted mortality (Knaus et al., 1991).

Patients reported their prior computer use as none, use of ATM only, can use E-Mail and word processing, video games only, and daily use of computers for work or pleasure. Patients were also asked to rate communication difficulty after each observation session. They answered a single question by using a Likert scale from 1 to 5: *Overall, how difficult was it for you to*

*communicate with the nurse?* 1 was the lowest difficulty (not difficult), and 5 was the highest (extremely difficult).

Nurse demographic information drawn from the SPEACS database were self-reported by the nurse participants and included age, gender, race, credentials, years in practice, years in critical care practice, and CCRN certification. Demographic data for both nurses and patients were used to describe to sample as well as help identify patterns and use of AAC.

### **3.3.2 Video Recorded Observations**

The dataset contained four video recorded observations of each nurse-patient dyad (twice daily, morning and afternoon) for the two days after the SLP assessed patient communication function and preferences and provided low tech AAC tools and an electronic AAC device to the patient. Video recording commenced when the nurse entered the patient's room and ended when the nurse exited the room. Observations ranged in length from 3:25 to 19:38 minutes (mean 8:17, SD 4:14) and the total dataset is approximately 300 minutes. The four full-length videos for each patient were coded at the communication act level for patient natural communication modality, patient low tech AAC, patient high tech AAC communication modality, nurse low tech AAC behaviors/strategies, nurse high tech AAC behaviors/strategies, and topic. "A communication act is a unit of communicative behavior, nonvocal or verbal, that is directed from one conversational participant to another in an attempt to convey a message" (Calculator & Luchko, 1983).

Before beginning data collection, the data were prepared, the tool refined, and competency in coding was established. Transcription was available in the parent study database for the first three minutes of each of the 36 videos used in this study. Preparing the data involved transcribing the videos after the three-minute mark and dividing (or segmenting) the transcript

into individual patient or nurse communication acts. The transcription rules from the SPEACS study were applied, and the format of the newly transcribed video segments match that of the first three minutes of video.

The coding definitions for nurse low tech AAC facilitative behaviors/strategies, nurse high tech AAC facilitative behaviors/strategies, patient's natural communication modality, patient's low tech AAC, and patient high tech AAC communication modality were drawn from the SPEACS study in which raters achieved > 95% coding agreement (M. Happ, unpublished data). The topic codes and definitions used were developed for this study. In this investigation, each patient communication act was coded for topic, whereas topic codes were assigned by communication exchange (i.e., a series of at least two shared conversational turns between a sender and receiver that attempt to achieve a joint communication goal) in the SPEACS study.

### **3.3.3 Topic**

The initial topic code list was created through review of the SPEACS study topic codes as well as a literature review performed to identify common patient communication topics and to construct topic definitions and defining criteria (Adams, Connolly, Oglesby, & Mason, 1993; Ashworth, 1980; Baker & Melby, 1996; Fowler, 1997; Happ, Roesch, & Garrett, 2004; Happ, Tuite, Dobbin, DiVirgilio-Thomas, & Kitutu, 2004; Leathart, 1994; Reed, Reineck, Fonseca, 2011; Rodriguez & Rowe, 2010; Wojnicki-Johansson, 2001). The topic list developed consisted of 10 patient communication act topics. Content experts were consulted to validate the topic categories and definitions. The definitions were revised and a final topic list was created.

The tool was first applied by two trained raters to patient communication acts in two videos of different patient-nurse dyads. The two raters then applied the tool to five video

recordings randomly selected from the remainder of the SPEACS dataset not used for the current study. The patients were physically and cognitively intact during the session used in reliability testing, but they were not cognitively and physically intact for all four video-taped sessions making them ineligible to be included in the study. We achieved an overall interrater reliability of 92.9% (80.8%, 100%, 93.5%, 84.8%, 96.1%) agreement. The two raters discussed instances of disagreement in coding the five sessions and added detail to the tool where necessary. We also determined that topic may be inflated in certain sessions when the patient repeated themselves multiple times before being understood. Instead of giving the repeated utterance/act the same topic code multiple times, an 11<sup>th</sup> topic code was created. The 11<sup>th</sup> topic was ‘repetition of previous topic/utterance/communication act’ and this code was used when the patient repeated the previous act or utterance because their communication was not understood or misinterpreted. The two raters coded two more sessions separately to determine interrater reliability and agreement after the changes were made to the tool. The percentage agreement for those two sessions was 81.6% and 84.2%. We found that coding the topic of an individual patient communication act can be complicated and sometimes involves interpreting the meaning (topic) of a nonverbal act. Accordingly, all cases were reviewed for consistency in topic coding by the thesis adviser, a senior researcher with expertise in nurse-patient communication in the ICU and video analysis, with adjudication as needed.

The final topic coding tool used to code this study data set included the following topics: (1) pain, (2) other symptoms, (3) comfort care/needs, (4) greeting/small talk/social etiquette/jokes, (5) attention getting/summons for assistance, (6) specific conversation – extended social conversation, (7) home/family/friends/pets/personal business, (8) patient’s condition/treatment plan/decision making, (9) emotional messages, (10) communication aid, and

(11) repetition of previous topic/utterance/communication act. The definition of each topic can be found in Appendix A.

### 3.3.4 AAC Use

The AAC use variables were measured for nurse and patient: nurse low tech AAC facilitative behaviors/strategies, nurse high tech AAC facilitative behaviors/strategies, patient's natural communication modality, patient's low tech AAC, and patient high tech AAC communication modality. These categories and definitions were drawn from the SPEACS study. **Nurse low tech AAC behaviors/strategies** are behaviors that facilitate the use of low tech AAC materials and include: uses partner dependent auditory scanning technique, presents items needed (e.g., clipboard, pen, eye gaze board) for low tech communication (at patient's request), and instructs patient to refer to chart-based encoding strategy/interprets response. The **nurse high tech AAC behaviors/strategies** facilitate electronic AAC device use: positions device appropriately so that patient can physically access it, and reviews display/potential messages with patient when necessary. The **patient's natural communication modality** category consisted of mouthing, gesture (e.g., waving around the room, pointing, symbolic gestures, social gestures), head nod yes/no or thumbs up/down yes/no, facial expression (e.g., smile, frown), non-verbal (but communicative) action (e.g., purposeful looking, purposeful squeeze), and audible (around trach) vocalization or speech. **Patient's low tech AAC communication** category included drawing, writing, point to partner – generated written word choices, point to partner – generated points on a graphic scale, first letter spelling while mouthing words, point to alphabet board, point to locations on a drawn map, point to an encoded symbol representing a phrase, indicate letter in response to partner's auditory/visual scanning of alphabet, indicate phrase in response to

partner’s auditory/visual scanning of phrase choice list, talking trach valve, eye gaze, and prepares message in advance of nurse caregiver. The **patient high tech AAC communication modality** category contained electronic devices (the specific high tech device was identified with a unique code consistent with the SPEACS study), and usage modes: direct selection – spell, direct selection – message (e.g. word, picture, phrase), scan – word, picture, and scan – spell. Devices used in the SPEACS study were selected by a speech language pathologist co-investigator who was skilled in the use of AAC in the medical setting and ranged from low level simple message digital recorders to complex multi-level dynamic display touch screen devices with synthesized speech (Garrett et al, 2008).

Interrater reliability was determined for these categories after two individual raters coded two sessions and achieved a percentage agreement of 97% and 90%. The two sessions were drawn from the testing dataset of patients that were physically and cognitively intact for at least one but not all sessions as described above. The type of electronic AAC device used in all of the sessions, both interrater reliability and actual dataset, were verified with the speech language pathology notes. See Table 1. for device list.

**Table 1. Electronic Devices Assigned to Study Patients**

<b>Patient</b>	<b>Electronic Device</b>	<b>Description</b>
1	Lightwriter	Typing text - speech
2	TechSpeak	Expandable multilevel recorder
3	Dynamyte	Dynamic display with synthesized speech
4	Lightwriter	Typing text - speech
5	TechSpeak	Expandable multilevel recorder
6	Lightwriter	Typing text - speech

7	Supertalker	Simple recorder with card overlays
8	Lightwriter	Typing text - speech
9	BlueBirdIII	Prerecorded messages with picture overlays

All of the behaviors were coded at the communication act level, and interrater reliability involved agreement of the occurrence of the target behavior at the act level for all categories except nurse facilitative behaviors. Nurse facilitative behaviors such as positioning the devices sometimes spanned multiple communication acts. Accordingly, interrater reliability for this category was computed as agreement on a total number of target behaviors in each session.

Once competency in coding was established, the full-length videos of all 36 sessions (four per patient) were coded for topic. All recordings after the three-minute mark were coded for nurse low tech AAC behaviors/strategies, nurse high tech AAC behaviors/strategies, patient's natural communication modality, patient's low tech AAC, and patient high tech AAC communication modality and merged with the data on the first three minutes from the SPEACS study.

### 3.4 ANALYSIS

Demographic characteristics of patients and nurses were displayed by case and aggregated by simple measures of dispersion (i.e., sums, ranges (min – max), means and standard deviations) to describe the sample. Patient ease of communication ratings were displayed by session for each patient and averaged across sessions (each case). We categorized patients as those with any use

(or nonuse) of high tech AAC; users demonstrated high tech AAC use at least once during the video observations.

### **3.4.1 Research Question 1**

*How do nonvocal intensive care patients use electronic communication devices?*

Analysis related to this question involved identifying which high tech communication devices were used. Devices were listed by patient and counted by type and use category. Nurse facilitative behaviors for low tech AAC and high tech AAC were summed by session, totaled for each patient and graphed across sessions for each patient. The topics (defined in Appendix A) were summed for each session, for each patient, and the group. The topic codes for high tech AAC communication acts were extracted, aggregated and displayed in a bar graph for each patient (see Appendices C-K). The rate of AAC use was calculated for the first three minutes and for the remaining time (after the first three minutes) by dividing the sum of communication acts by the video observation time period. Patient high tech AAC communication modality use was summed by communication modality (direct selection – spell, direct selection – message, scan – word, picture, scan – spell) per session and across all four session and for each session in total (see Appendices C-K). A table containing the total of each type of communication (natural, low, and high) by session was constructed to compare high tech AAC use to natural communication modality and low tech AAC use in order to see the extent to which high tech AAC techniques were used in conjunction with other methods.

### **3.4.2 Research Question 2**

*How does AAC use change during the two days directly after receiving the device?*

Communication methods and device use were summed for each session. Three tables were created per patient to show communication methods (natural communication modality, low tech AAC, and high tech AAC) used in each session and overall (e.g. in total). Totals were calculated for each session as well as each method within the category (for example mouthing, gesture, etc.) for patient's natural communication modality use. The total for each type of communication by session were combined and displayed in a line graph showing natural, low tech, and high tech patient communication by session over the four sessions (four time points). This was used to determine, via visual pattern inspection and comparison, how use changed over time. AAC usage was also computed as a rate calculation (per minute) for each patient (see Appendices C-K) for each session and plotted as a line graph to show change or patterns of use over time.

## **4.0 RESULTS**

### **4.1 DEMOGRAPHIC DATA**

The sample consisted of nine patients and six nurses. Three nurses were paired with two patients each, and three nurses were paired with one study patient each. The patient demographic and clinical characteristics are displayed in Table 2. The patients ranged in age from 31 to 70 years, and the mean age was 50.56 years (SD=12.20). Six of the patients were male and three were female. All nine patients in this study were white. High school or GED was the highest education level for most patients (n=6); two held a Bachelor's degree, and one had a Master's degree. Five patients had adequate/unimpaired hearing whereas four patients had impaired hearing. All patients had adequate vision with or without correction; however three patients did not have their corrective lenses available in the ICU. Each patient had between one and three diagnoses (mean 1.67), and there were a total of fifteen diagnoses for these nine patients. Pulmonary disease/infection was the most common diagnosis (n=5). The severity of illness (APACHE III) scores for these nine patients on enrollment to the SPEACS study ranged from 18 to 72. The mean score was 45.89 (SD =18.49). The ICU length of stay ranged from 16 to 262 days with a mean of 113.56 days (SD= 95.37). Eight patients had a tracheostomy, whereas only one patient was orally intubated. The numbers of days that the patient was intubated before study enrollment ranged from 13 to 86 days with a mean of 29.11 days (SD= 23.69). Prior computer use ranged

from none (n=1) to daily use of computers for work and pleasure (n=6).. Tables 3 and 4 contain results specifically about each patient according to category of AAC device use. The patients were categorized as users (n=5) or nonusers (n=4) of high tech AAC during this study. The device users demonstrated use of high tech AAC at least once during the video observations.

**Table 2. Patient Demographic Data**

<b>Patient Characteristics</b>	<b>Total (n=9)</b>
<b>Age, mean (SD)</b> <b>Range 31-70 years</b>	50.56 (12.20)
<b>Sex, n (%)</b> Female Male	3 (33.33) 6 (66.67)
<b>Race, n (%)</b> Caucasian/White	9 (100)
<b>Education Level, n (%)</b> High School GED Bachelor's Master's	5 (55.56) 1 (11.11) 2 (22.22) 1 (11.11)
<b>Hearing, n (%)</b> Impaired Adequate/unimpaired	4 (44.44) 5 (55.56)
<b>Vision</b> Adequate Adequate with correction and corrective lenses available Adequate with correction; corrective lenses not available	1 (11.11) 5 (55.56) 3 (33.33)
<b>Admitting Diagnosis</b> Postoperative complications Pulmonary disease/infection Renal or liver failure Neurologic disorder Heme/Onc CHF, Cardiomyopathy Cardio, thoracic, or vascular surgery Transplant	1 (6.67) 5 (33.33) 1 (6.67) 1 (6.67) 1 (6.67) 1 (6.67) 3 (20.00) 2 (13.33)
<b>APACHE III, mean (SD)</b> <b>Range 18-72</b>	45.89 (18.49)
<b>ICU Length of Stay, mean (SD)</b> <b>Range 16-262</b>	113.56 (96.37)

**Table 2 (continued)**

<b>Days intubated prior to study, mean (SD)</b> <b>Range 13-86</b>	29.11 (23.69)
<b>Type of Intubation, n (%)</b> Tracheostomy ETT	8 (88.9) 1 (11.1)
<b>Prior Computer Use, n (%)</b> None Can use E-Mail and word processing Daily use of computers for work or pleasure	1 (11.11) 2 (22.22) 6 (66.67)
Notes. APACHE III = Acute Physiology and Chronic Health Evaluation III ETT= endotracheal tube; CHF = congestive heart failure; Heme/onc = hematology/oncology	

**Table 3. Patient Demographic Data of High Tech AAC Users (Users)**

<b>Patient/Case</b>	<b>1</b>	<b>2</b>	<b>4</b>	<b>6</b>	<b>8</b>	<b>Total</b>
<b>Age (years)</b>	43	55	39	54	31	Mean: 44.4 SD: 10.19
<b>Gender (M/F)</b>	M	M	F	M	M	4 M / 1 F
<b>Education Level</b>						
GED/High School				X	X	2
Some college		X				1
Bachelor's degree	X		X			2
Master's degree						
<b>Hearing</b>						
Impaired		X		X		2
Adequate/unimpaired	X		X		X	3
<b>Vision</b>						
Adequate					X	1
Adequate with correction and corrective lenses available		X	X			2
Adequate with correction and corrective lenses not available	X			X		2
<b>Admitting Diagnosis</b>						
Pulmonary Disease/Infection				X	X	2
Cardio, Thoracic, or Vascular Surgery		X	X			2
Transplant	X	X				2
Post-op Complications						

**Table 3 (continued)**

CHF/Cardiomyopathy						
Heme/Onc						
Neurologic Disorder						
<b>APACHE III</b>	51	72	31	32	18	Mean: 40.8 SD: 21.04
<b>ICU Length of Stay</b>	148	50	16	46	262	Mean: 104.6 SD: 101.01
<b>Days intubated prior to study enrollment</b>	17	22	13	26	35	Mean: 22.6 SD: 8.50
<b>Type of Intubation</b>	Trach.	Trach.	Trach.	Trach.	Trach.	5 Trach
<b>Prior Computer Use</b>	Daily	Email/WP	Daily	Daily	Daily	4 Daily 1 Email/WP
<b>Electronic AAC Assigned</b>	Lightwriter	TechSpeak	Lightwriter	Lightwriter	Lightwriter	4 Lightwriter 1 TechSpeak
<b>RN Assigned</b>	A	B	D	E	F	

**Table 4. Patient Demographic Data of High Tech AAC Nonusers (Nonusers)**

<b>Patient/Case</b>	<b>3</b>	<b>5</b>	<b>7</b>	<b>9</b>	<b>Total</b>
<b>Age (years)</b>	53	64	70	46	Mean: 58.25 SD: 10.78
<b>Gender (M/F)</b>	F	M	M	F	2 M / 2 F
<b>Education Level</b>					
GED/High School	X	X	X		3
Some college					
Bachelor's degree					
Master's degree				X	1
<b>Hearing</b>					
Impaired		X		X	2
Adequate/unimpaired	X		X		2
<b>Vision</b>					
Adequate					
Adequate with correction and corrective lenses available	X	X		X	3
Adequate with correction and corrective lenses not available			X		1
<b>Admitting Diagnosis</b>					
Pulmonary Disease/Infection		X	X	X	3
Cardio, Thoracic, or Vascular Surgery	X				1
Transplant					
Post-op Complications\	X				1

**Table 4 (continued)**

CHF/Cardiomyopathy	X				1
Heme/Onc		X			1
Neurologic Disorder			X		1
Renal or Liver Failure				X	1
<b>APACHE III</b>	65	34	46	64	Mean: 52.25 SD: 14.97
<b>ICU Length of Stay</b>	160	70	20	250	Mean: 125 SD: 101.49
<b>Days intubated prior to study enrollment</b>	40	14	9	86	Mean: 37.25 SD: 35.23
<b>Type of Intubation</b>	Trach.	Trach.	ETT	Trach.	3 Trach 1 ETT
<b>Prior Computer Use</b>	Daily	Email/WP	None	Daily	2 Daily 1 Email/WP 1 None
<b>Electronic AAC Assigned</b>	Dynamyte	TechSpeak	Supertalker	BlueBirdIII	1 Dynamyte 1 TechSpeak 1 Supertalker 1 BlueBirdIII
<b>RN Assigned</b>	C	D	E	F	

Table 5 contains the communication difficulty ratings for each patient. The mean communication difficulty ratings ranged from 1.00 to 3.0, and the group mean was 1.74.

**Table 5. Single-Item Communication Difficulty Rating by Patient (Non-users shaded)**

<b>Patient</b>	<b>Session 1</b>	<b>Session 2</b>	<b>Session 3</b>	<b>Session 4</b>	<b>Mean (SD)</b>
<b>1</b>	2	2	2	---	2 (0)
<b>2</b>	2	1	1	1	1.25 (0.5)
<b>3</b>	2	2	2	2	2 (0)
<b>4</b>	1	1	1	1	1 (0)
<b>5</b>	2	2	2	1	1.75 (0.5)
<b>6</b>	---	1	2	2	1.67 (0.58)
<b>7</b>	1	1	1	1	1 (0)
<b>8</b>	1	2	4	1	2 (1.41)
<b>9</b>	3	3	3	---	3 (0)

Six nurses, 1 male and 5 females, were observed in this study. (See Table 6). Three nurses took care of one study patient each, and three nurses cared for two study patients each. All three nurses that took care of two study patients had one patient that used high tech AAC and one who did not. Nurses ranged in age from 26 to 42 years; mean age was 32.5 years (SD= 7.18). All six nurses were white. Most (n=4) had a Bachelor's degree in nursing or another field; none had attained CCRN (critical care registered nurse) certification. Their years in practice ranged from two to 10 years with a mean of 3.83 years (SD= 3.31), with similar years in critical care practice.

**Table 6. Nurse Demographic Data (n=6)**

<b>Nurse</b>	A	B	C	D	E	F	<b>Summary</b>
<b>Patient (dyad)</b>	1	2	3	4, 5	6, 7	8, 9	9 patients
<b>Gender (M/F)</b>	F	F	F	F	M	F	1 M / 5 F
<b>Age (years)</b>	26	35	28	25	39	42	Mean: 32.5 SD: 7.18
<b>Race (white)</b>	W	W	W	W	W	W	6 White
<b>Highest Education in Nursing</b>	BSN	AD	AD	BSN	BSN	BS	2 AD, 3 BSN, 1 BS
<b>Years in Practice</b>	4	10	3	2	2	2	Mean: 3.83 SD: 3.13
<b>Years in Critical Care Practice</b>	3	9	3	2	2	2	Mean: 3.6 SD: 2.74

## **4.2 RESEARCH QUESTION 1**

*How do nonvocal intensive care patients use electronic communication devices?*

### **4.2.1 Devices Used**

The high tech AAC device options and features for this sample are shown in Table 1. Table 7 shows how many patients received each type of device and which devices were provided to those patients with observed high tech AAC use and the nonuser group. The Lightwriter device was most common (n=4) and was most popular among the electronic AAC users.

**Table 7. Number of Patients and Usage Category for Each Type of Electronic Device**

Device	Users (n=5)	Nonusers (n=4)	Total (n=9)
Lightwriter	4	0	4
TechSpeak	1	1	2
Dynamyte	0	1	1
Supertalker	0	1	1
BlueBird III	0	1	1

#### **4.2.2 Nurse Facilitative Behaviors**

Nurse facilitative behaviors were observed in most dyads (n=7) with both high tech AAC users and nonuser patients. These nurse behaviors reflect attempts to facilitate both low tech and high tech AAC tools. The most nurse facilitative behaviors within one case was twelve behaviors seen with patient 7 (nonuser). The second most nurse facilitative behaviors occurred with Patient 1 (user). Tables 8 and 9 show the nurse facilitative behaviors for patient 1 and 7. Table 10 shows the nurse facilitative behaviors for all of the patients together.

**Table 8. Nurse Facilitative Behaviors for Patient 1 (User)**

	Nurse Low Tech AAC Behaviors/Strategies		Nurse High Tech AAC Behaviors/Strategies			Total
	Presents items needed (e.g., clipboard, pen, eye gaze board) for low tech communication	Instructs patient to refer to chart-based encoding strategy/interpret s response	Positions device appropriately so that patient can physically access it	Reviews display/potential messages with patient when necessary	Physically assists patient to communicate	
Session 1	0	0	0	3	1	4
Session 2	2	0	1	0	1	4
Session 3	0	1	0	0	0	1
Session 4	0	0	0	0	0	0
Total	2	1	1	3	2	9

No occurrence of the following: Uses partner dependent auditory scanning technique, provides written word choices (auditorially & graphically).

**Table 9. Nurse Facilitative Behaviors for Patient 7 (Nonuser)**

	Nurse Low Tech AAC Behaviors/Strategies	Nurse High Tech AAC Behaviors/Strategies		Total
	Presents items needed (e.g., clipboard, pen, eye gaze board for low tech communication)	Positions device appropriately so that patient can physically access it	Physically assists patient to communicate	
Session 1	0	0	0	0
Session 2	0	2	0	2
Session 3	0	0	0	0
Session 4	8	0	2	10
Total	8	2	2	12

No occurrence of the following: Uses partner dependent auditory scanning technique, provides written word choices (auditorially & graphically, instructs patient to refer to chart-based encoding strategy/interprets response, reviews display/potential messages with patient when necessary.

**Table 10. Nurse Facilitative Behaviors for All Patients**

	<b>Nurse Low Tech AAC Behaviors/Strategies</b>				<b>Nurse High Tech AAC Behaviors/Strategies</b>			<b>Total</b>
	Uses partner dependent auditory scanning technique	Presents items needed (e.g., clipboard, pen, eye gaze board) for low tech communication	Provides written word choices (auditorially & graphically)	Instructs patient to refer to chart-based encoding strategy/interprets response	Positions device appropriately so that patient can physically access it	Reviews display/potential messages with patient when necessary	Physically assists patient to communicate	
Patient 1	0	2	0	1	1	3	2	9
Patient 2	0	2	0	0	1	0	0	3
Patient 3	0	0	0	0	1	0	2	3
Patient 4	0	0	0	0	2	0	0	2
Patient 5	0	0	0	0	0	0	0	0
Patient 6	0	0	0	0	1	0	0	1
Patient 7	0	8	0	0	2	0	2	12
Patient 8	0	0	0	0	0	0	0	0
Patient 9	0	2	0	0	0	0	0	2
<b>Total</b>	0	14	0	1	8	3	6	32

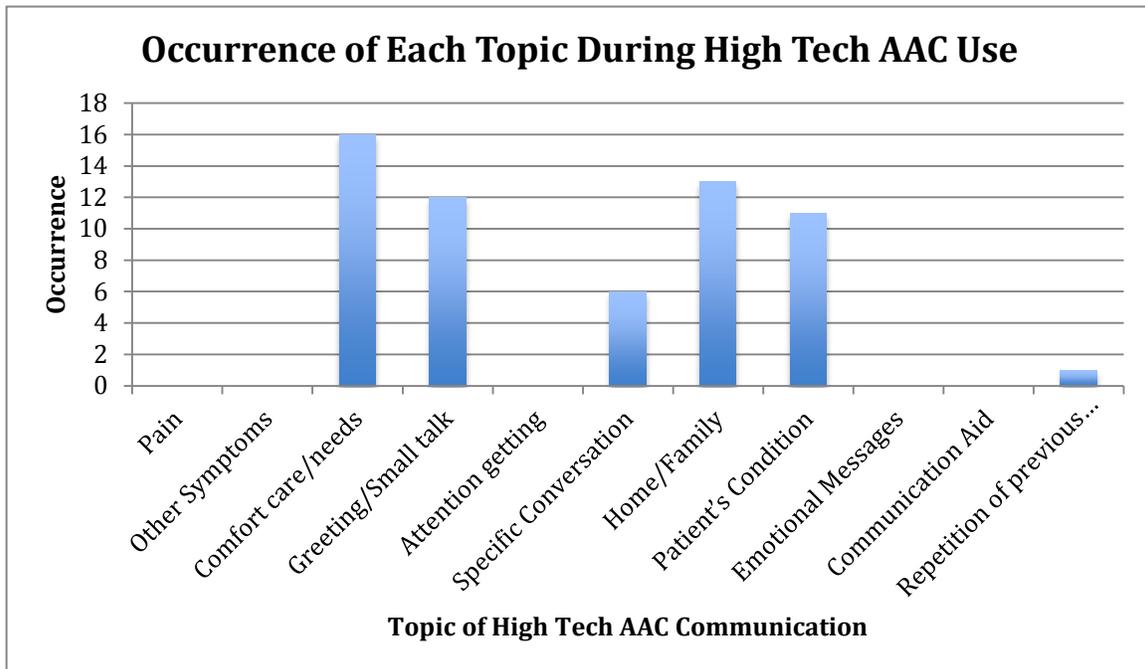
The nurse working with patient 1 (a high tech AAC user) is presented as an exemplar. This nurse demonstrated AAC facilitative behaviors nine times during the observations. She presented items needed for low tech communication twice, instructed the patient to refer to chart-based encoding strategy/interpreted response once, positioned the device appropriately so that the patient could physically access it once, reviewed display/potential messages with the patient when necessary three times, and physically assisted the patient to communicate twice. The behavior of positioning the high tech device appropriately was the most common facilitative behavior with high tech AAC user patients, occurring with most (4/5) of the patients who used tech AAC during observations (table IV. for each patient, see Appendices C-K).

The nurse taking care of patient 7 (high tech AAC nonuser) is also presented as a second exemplar. This nurse exhibited facilitative behaviors twelve times, primarily presented items needed (e.g., clipboard, pen, eye gaze board) for low tech communication (i.e., eight times during this case). Presenting items needed for low tech communication was the most frequent nurse facilitative behavior seen overall when considering all patients, but most (8/12) occurrences took place with patient 7. Patient 7's nurse also positioned the device appropriately so that the patient could physically access it. This is the same behavior that was seen with the majority of patients who used high tech AAC devices. This nurse also physically assisted the patient to communicate twice.

#### **4.2.3 Topic for High Tech AAC Communication**

The topic of high tech AAC communication was explored within the cases where device use was observed. The acts that were communicated with a high tech communication modality were

separated, and the topics are represented in a bar graph for each user patient. The bar graph for patient 4 appears in Figure 1 below as an exemplar.



**Figure 1. Occurrence of Each Topic During High Tech AAC Use for Patient 4**

Patient 4 demonstrated the most communication with high tech AAC (59 high tech communication acts), and the topics of her high tech AAC communication acts can be seen above. Comfort care/needs (16 communication acts) was the most frequent topic of her high tech communication acts. Comfort care/needs was also the most frequent overall topic for this patient when considering all of her communication (natural, low tech, and high tech). Other topics that were frequently used by this patient with high tech AAC were home/family (13 communication acts), greetings/small talk (12 communication acts), and patient's condition (11 communication acts). The greetings/small talk category includes social etiquette as well as jokes and humorous comments. These topics were also the patient's most common topics overall regardless of communication modality used. In all four sessions together, the patients most used topics were

comfort care/needs (77 out of 213 (36.15%) communication acts), patient's condition (57 out of 213 (26.76%) communication acts), home/family (30 out of 213 (14.08%) communication acts), and greeting/small talk (27 out of 213 (12.68%) communication acts). Table 11 shows the topic occurrence by session and in total for patient 4.

Patient 1 demonstrated the second most communication with high tech AAC (31 communication acts). Home/family (5 communication acts) and emotional messages (5 communication acts) were this patient's most used topics during communication with high tech AAC. Home/family was the main topic of conversation (41 out of 161 communication acts) overall for this patient regardless of communication modality used. Although this patient did not discuss emotional messages frequently overall (10 out of 161 communication acts), he used high tech AAC for half (5) of these communication acts related to emotion.

The other patients in this study who used high tech AAC devices had much less frequent use than patient 4 and patient 1. Patient 2 used the device only once and the topic was comfort care/needs. This was also the main topic of this patient's communication overall (natural, low tech, and high tech). Patient 6 used the high tech AAC device three times to communicate. The topics of these communication acts were pain (once) and home/family (twice). Patient 8 communicated with the high tech AAC device twice and the topics were greeting/small talk and communication aid. The topics in total for user and nonuser patients can be found in Table 12.

**Table 11. Topic Occurrence by Session for Patient 4 (User)**

<b>Topic</b>	<b>Session 1</b>	<b>Session 2</b>	<b>Session 3</b>	<b>Session 4</b>	<b>Total</b>
Pain	0	0	0	0	0
Other Symptoms	0	2	0	0	2
Comfort care/needs	51	16	3	7	77
Greeting/Small talk	19	5	1	2	27
Attention getting	0	0	0	0	0
Specific Conversation	1	11	0	0	12
Home/Family	1	2	21	6	30
Patient's Condition	23	13	14	7	57
Emotional Messages	0	0	0	1	1
Communication Aid	2	0	0	3	5
Repetition of previous topic/utterance/communication act	0	0	1	0	1
Unable to interpret	0	0	1	0	1
<b>Total</b>	<b>97</b>	<b>49</b>	<b>41</b>	<b>26</b>	<b>213</b>

**Table 12. Topic Occurrence Overall by High Tech AAC Users and Nonusers**

<b>Topic</b>	<b>AAC User number (%)</b>	<b>Nonuser number (%)</b>	<b>All Patients number (%)</b>	<b>High Tech AAC Communication Acts number (%)</b>
Pain	16 (2.12%)	51 (9.94%)	67 (5.29%)	1 (1.18%)
Other Symptoms	31 (4.11%)	16 (3.12%)	47 (3.71%)	2 (2.35%)
Comfort care/needs	253 (33.55%)	130 (25.34%)	383 (30.23%)	21 (24.71%)
Greeting/Small talk	94 (12.47%)	83 (16.18%)	177 (13.97%)	16 (18.82%)
Attention getting	0	4 (0.78%)	4 (0.32%)	0
Specific Conversation	12 (1.59%)	15 (2.92%)	27 (2.13%)	6 (7.06%)
Home/Family	82 (10.88%)	17 (3.31%)	99 (7.81%)	20 (23.53%)
Patient's Condition	213 (28.25%)	134 (26.12%)	347 (27.39%)	11 (12.94%)
Emotional Messages	11 (1.46%)	9 (1.75%)	20 (1.58%)	5 (5.88%)
Communication Aid	24 (3.18%)	16 (3.12%)	40 (3.16%)	1 (1.18%)
Repetition of previous topic/utterance/com munication act	11 (1.46%)	27 (5.26%)	38 (3.00%)	1 (1.18%)
Unable to interpret	7 (0.93%)	11 (2.14%)	18 (1.42%)	1 (1.18%)
<b>Total</b>	<b>754</b>	<b>513</b>	<b>1267</b>	<b>85</b>

#### **4.2.4 AAC Communication Acts**

We also examined the total number of AAC acts (low tech plus high tech) and whether they occurred during the first three minutes or after the three-minute mark. Rates were also calculated for AAC use during the first three minutes and for the rest of the session. The rates allow comparison within and across sessions and cases of different lengths. An example of an AAC Communication Acts table (table IX. for each patient, see Appendices C-K) for patient 2 can be found in Table 13. Table 14 shows the rate of AAC use during and after the three minute mark for each patient and overall.

**Table 13. AAC Communication Acts for Patient 2 (High Tech AAC User)**

	# of patient communication acts	# of AAC acts	# of AAC acts in first 3 minutes (rate = n/3)	Length of session after the 3 minute mark (x)	# of AAC acts after first 3 minutes (rate = n/x)
Session 1	15	0	0	3:12	0
Session 2	76	8	4 (1.33)	6:41	4 (0.60)
Session 3	79	1	0	10:55	1 (0.09)
Session 4	40	0	0	3:50	0
Totals	210	9	4 (0.33)	24:38	5 (0.20)

n = number of acts

x = length of remaining video (after 3 minutes)

**Table 14. Rate of AAC Use During and After the First 3 Minutes (High Tech AAC Users Shaded)**

	Rate During First Three Minutes	Length of Time after First Three Minutes	Rate after First Three Minutes
Patient 1	1.33	26:43	0.64
Patient 2	0.33	24:38	0.20
Patient 3	0.67	22:48	0.26
Patient 4	2.08	37:28	0.91
Patient 5	0.17	9:58	0.50
Patient 6	0.25	16:17	0
Patient 7	0.92	32:20	0.19
Patient 8	0.25	14:55	0.13
Patient 9	0	6:48	0.29
Total for all patients	0.67	191:55	0.40
Total for high tech users	0.85	120:01	0.48

Patient 2 used AAC (low tech and high tech) 0.33 times per minute during the first three minutes and 0.20 times per minute during the remaining time after the first three minutes. This patient utilized both low tech and high tech strategies.

All of the AAC use rates for the nine patients were below 1 time per minute except for patient 1 (1.33 times for minute) and patient 4 (2.08 times per minute) for the first three minutes of observation. The rates ranged from 0 to 2.08 with an overall rate of 0.67 AAC acts per minute during the first three minutes and 0.40 AAC acts per minute after thee three minute mark.

#### **4.2.5 Patient High Tech AAC Communication Modality**

Of the four patients who used high tech AAC, three of them used the device through the direct selection – spell modality. The number of times each patient used direct selection – spell can be seen in Table 15. The direct selection – message (e.g. word, picture, phrase) and scan – word, picture modalities were not used by any of the patients in this study.

**Table 15. High Tech AAC Communication Modality Used by Each Patient**

<b>Patient</b>	<b>High Tech AAC Communication Modality</b>	<b>Occurrence</b>
1	Direct Selection - Spell	31
2	Scan - Spell	1
4	Direct Selection - Spell	59
6	Direct Selection – Spell	3
8	Direct Selection - Spell	2

#### **4.2.6 Occurrence of Natural, Low Tech, and High Tech Patient Communication**

All patients in this study used more than one communication modality. All of the high tech AAC nonusers utilized both natural and low tech communication modalities. Three of the users (patient 1, patient 2, and patient 8) used all three communication modalities (natural, low tech, and high tech). The other two users (patient 4 and patient 6) used natural and high tech communication methods. Tables 16 and 17 show the occurrence of natural, low tech, and high tech patient communication for patient 2 and 8.

**Table 17. Occurrence of Natural, Low Tech, and High Tech Patient Communication for Patient 2 (High Tech AAC User)**

	Natural	Low Tech	High Tech	AAC Total	Total
Session 1	37	0	0	0	37
Session 2	97	8	0	8	105
Session 3	90	0	1	1	91
Session 4	60	0	0	0	60
Total	284	8	1	9	293

**Table 16. Occurrence of Natural, Low Tech, and High Tech Patient Communication for Patient 8 (High Tech AAC User)**

	Natural	Low Tech	High Tech	AAC Total	Total
Session 1	30	0	2	2	32
Session 2	38	0	0	0	38
Session 3	46	3	0	3	49
Session 4	30	0	0	0	30
Total	144	3	2	5	149

**Table 18. Occurrence of Natural, Low Tech, and High Tech Patient Communication for Patient 3 (Nonuser)**

	Natural	Low Tech	High Tech	AAC Total	Total
Session 1	18	0	0	0	18
Session 2	55	14	0	14	69
Session 3	41	0	0	0	41
Session 4	15	0	0	0	15
Total	129	14	0	14	143

Patient 3 (Table 18) used natural communication methods 129 times and low tech AAC 14 times. This pattern was seen in the other patients who did not use the high tech AAC devices as well. Patient 5 used natural communication modalities 310 times and low tech AAC seven times, and patient 9 used natural communication 107 times and low tech AAC modalities two times. Natural communication methods were the modality of choice for all patients.

### **4.3 RESEARCH QUESTION 2**

*How does AAC use change during the two days directly after receiving the device?*

In general, the occurrence of natural, low tech, and high tech patient communication was higher for the longer sessions. Thus, the rate of natural, low tech, and high tech communication occurrences per session was used for all comparisons. Figure 2, 3, 4, and 5 below show the rate of natural, low tech, and high tech occurrences for four exemplar patients – patient 2, patient 3, patient 4, and patient 6.

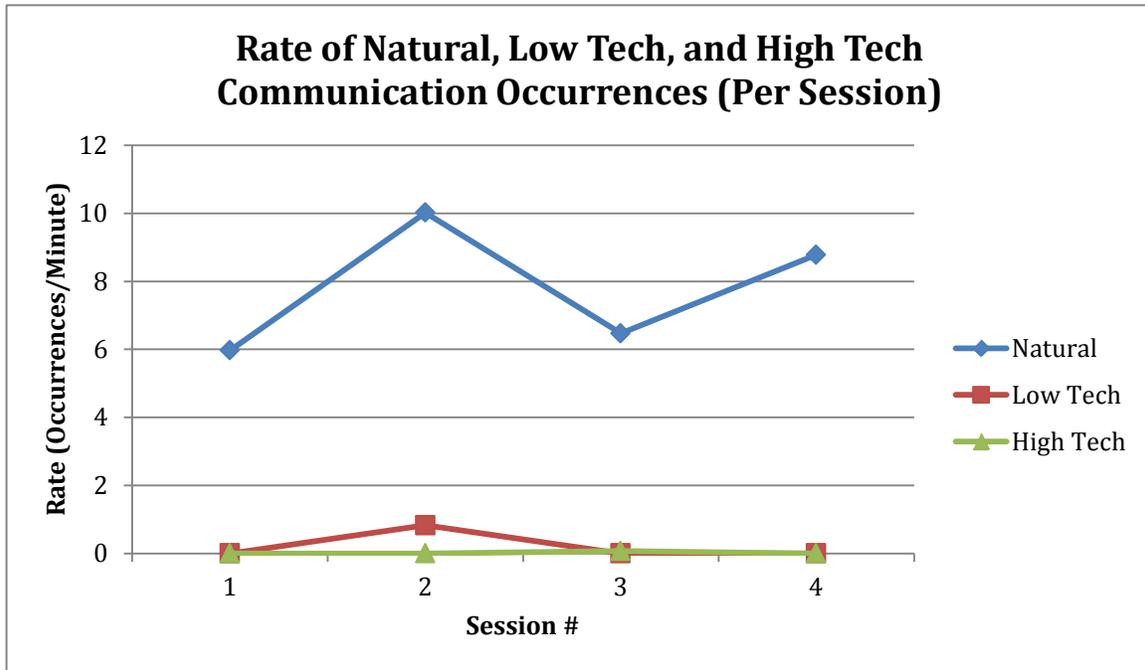


Figure 2. Rate of Natural, Low Tech, and High Tech\* Communication Occurrence (Per Session) for Patient 2

\*High tech AAC rate in session 3 is 0.07 occurrences per minute.

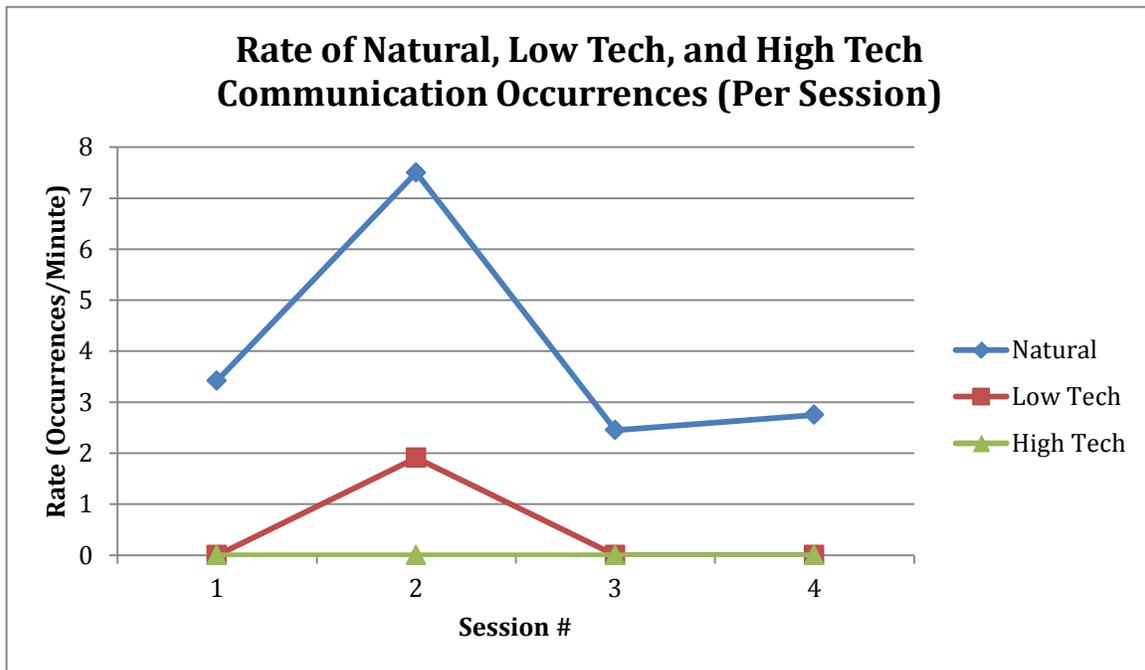


Figure 3. Rate of Natural, Low Tech, and High Tech Communication Occurrence (Per Session) for Patient 3

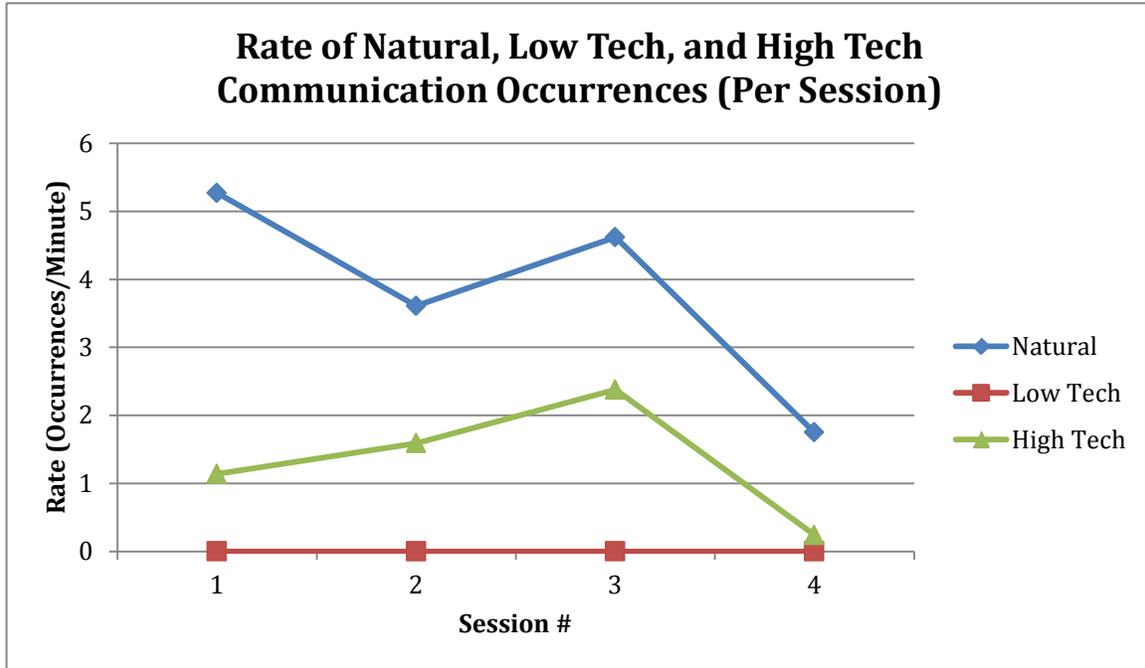


Figure 4. Rate of Natural, Low Tech, and High Tech Communication Occurrence (Per Session) for Patient 4

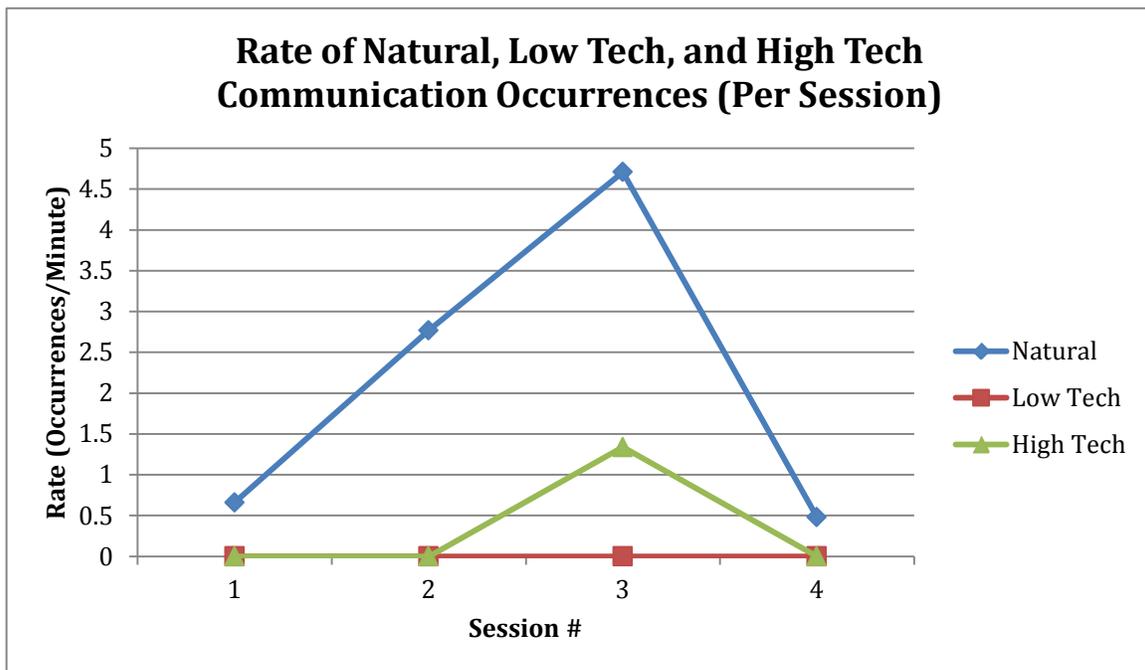


Figure 5. Rate of Natural, Low Tech, and High Tech Communication Occurrence (Per Session) for Patient 6

The pattern of AAC use over time was not the same for every patient. As can be seen from Figures 2-5, AAC use over time varied greatly. There was not a general increase in AAC

use or communication over time. The rate of natural communication was higher than the rate of low tech or high tech AAC use for all patients. In addition, increases and decreases in the rate of natural communication were frequently mirrored by changes in low tech AAC or high tech AAC. For example, in Figure 3 (patient 3) the rate of natural communication and the rate of low tech AAC use for patient 3 increased from session 1 to session 2 and decreased from session 2 to session 3. Similarly, in Figure 5 (patient 6) the rate of natural communication and high tech communication increased from session 2 to session 3 and decreased from session 3 to session 4. The session with the highest rate of communication varied by patient, but were located predominately in the middle two sessions (Day 1 afternoon or Day 2 morning). Communication rates dropped in eight of the nine cases during session 4. Three patients (6, 8, and 9) communicated at the highest rate during session 3, and three patients (2, 3, and 5) communicated at the highest rate during session 2. Rate of communication was highest for patient 1 and patient 4 in session 1. Patient 7 is the only patient where the rate of communication increased in the fourth session. Figure 6 shows the rate of natural, low tech, and high tech communication occurrences (per session) for patient 7.

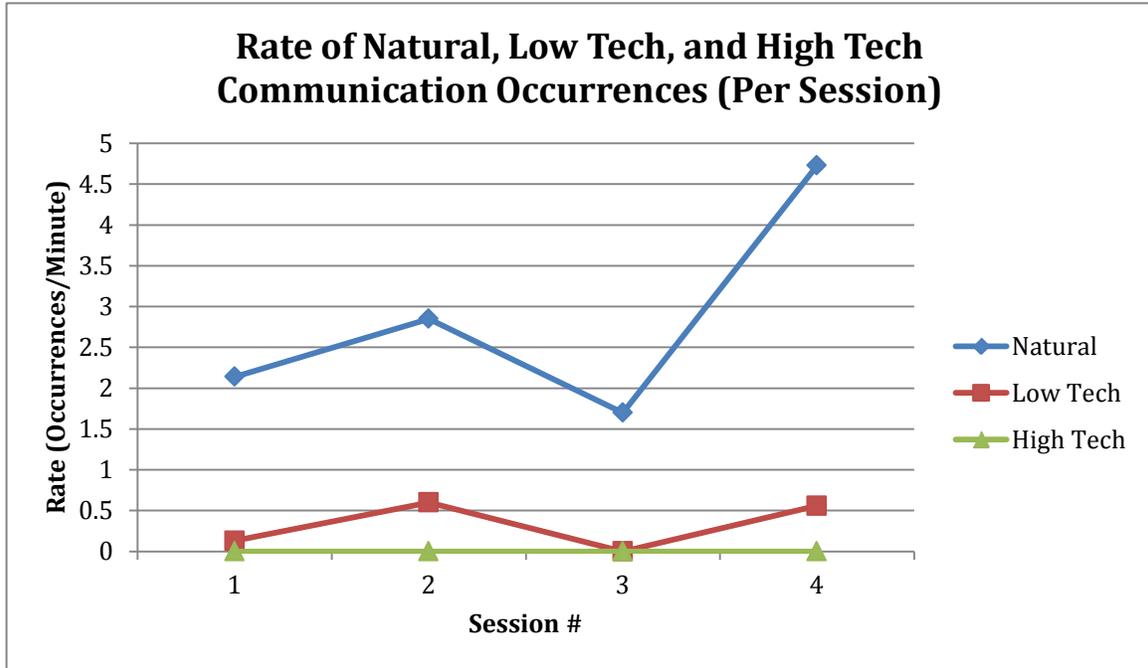


Figure 6. Rate of Natural, Low Tech, and High Tech Communication Occurrences (Per Session) for Patient 7

#### 4.4 LIMITATIONS

This study was limited by a small sample size wherein . only nine patients and six nurses were involved. In addition, there was little diversity in the sample. There were few women and no non-whites. The sample size and lack of diversity affected the type of analysis that could be done and the conclusions that can be drawn from the data. This study was also a secondary analysis and retrospective. Thus, we only had access to data that were collected as part of the initial study. Data about patient satisfaction with the device or what they did or did not like about the device were not available. In addition, the majority of the data was drawn from video-recorded observations. While there are several advantages to the video recordings in communication research, we were limited by the frame of the single camera’s view, angle and position. If the

nurse or others in the room blocked view of the patient's mouthing or gesturing, we were unable to determine exactly what they were mouthing or gesturing for topic coding. We were also unable to code and analyze any communication that occurred outside of the camera screen. The nurse sometimes moved out of view, while the camera remained focused on the patient as per study protocol. Videos were recorded four times (two times on two days). This was a limitation because there were only four observation points. We were not able to look at AAC use beyond the first two days after the observation or during times during those first few days when videos were not recorded such as at night, when the patient was with family, or in between sessions. In addition, we did not know what the patient was doing during the couple of hours before video taping began. It is difficult to interpret nonverbal communication, particularly for communication topic analysis, if the communication partner (nurse) does not repeat or confirm the message. All of the patients used natural communication modalities, which includes mouthing, gesture, and facial expression. Meaning (or topic) of a patient's gestures or facial expressions was not always clear. We did not code the function of each communication act or whether a communication breakdown (i.e., misunderstanding, misinterpretation, or receiver's inability to interpret a message) occurred. Nurses may use clarification to resolve a communication breakdown. We did not look at how many communication breakdowns occurred or what communication methods are used in these situations.

## **5.0 DISCUSSION**

This study is the first to explore the enactment and progression of AAC device use during nurse-patient communication in the ICU over time, specifically, a 2-day observation period. Contrary to our expectations, natural communication remained the primary communication modality, the rate of AAC use remained low across sessions, and device use did not increase over the two day period or have a consistent pattern of use over time. Mixed modality use was the commonality across the sample. Overall, natural communication modalities were preferred in communication between these patients and nurses in the ICU. High tech AAC seems to contribute in greater proportions for specific communication topics beyond the patient's condition or ICU treatment, such as home-family and emotions. Specific findings and implications for practice and future research are discussed in the following sections.

### **5.1 SAMPLE DEMOGRAPHICS**

On average, the patients in this study ( $n = 9$ ) were slightly younger in age (50.56 years; SD 12.20) to the larger data set of patients in the SPEACS study ( $n = 89$ ), which included patients that were not physically and cognitively intact for all four sessions. (56.8 years; SD 15.7) (Nilsen, Sereika, & Happ, 2013). In the SPEACS study, there were equal numbers of men and women, whereas there were twice as many men than women in our sample (three females and

six males) (Nilsen, Sereika, & Happ, 2013). In this study all of the patients were white, and in the SPEACS study, the majority of patients were white (79 out of 89) (Nilsen, Sereika, & Happ, 2013). Education level was similar between those in this study and the full sample. On average, severity of illness (APACHE III score) for our study patients was lower (45.89; SD 18.49), than for the SPEACS sample as a whole (53.4; 16.6) (Nilsen, Sereika, & Happ, 2013). As a group, these patients were intubated longer prior to study enrollment (29.11 days; SD 23.69) than the patients in the full SPEACS sample (23.0 days; SD 24.5) (Nilsen, Sereika, & Happ).

## 5.2 RESEARCH QUESTION 1

*How do nonvocal intensive care patients use electronic communication devices?*

The Lightwrtier was the most common device given to patients (n = 4). Four of the five patients observed to use high tech AAC received this device. In this retrospective analysis, we are not able to determine if patients preferred the Lightwriter over the other devices because of certain features of the device, however, we do know that patients were involved in device selection. The Lightwriter is a direct selection – spell device and typing may have been easy for the patients since many people know and are accustomed to this communication skill. In addition, patients were able to type unique messages during a conversation, while this was not possible with some of the other devices in which only pre-recorded messages were available. Rodriguez and Rowe (2010) investigated the satisfaction level of patients who received an electronic speech-generating device after surgery for head and neck cancer. The mean satisfaction score for all items on the Satisfaction and Usability Instrument was 4.18 on a 5-point scale, indicating that hospitalized nonvocal participants in that study were satisfied with high

tech AAC use. Feedback from patients included that they had to handwrite in addition to using the device to communicate. They also reported factors that inhibited their ability to use the device, such as characteristics of the device, accessibility of the device, and specific needs not met by the device (Rodriguez & Rowe, 2010). This shows that features of the high tech AAC device do matter to patients and could affect how they are used. It is possible that the devices chosen for use in this study are not best suited to the ICU patient or setting. In addition, our study confirms Rodriguez and Rowe's finding that patients may combine writing and other techniques with AAC device use.

Nurse facilitative behaviors were observed with most (7/9) patients. Specifically, nurses positioned the device appropriately so the patient could access it. This shows the role of the nurse in assisting patients to use AAC devices. Positioning the device appropriately was only seen with two of the patients who did not use the electronic device as compared to four patients who used the device at some point during observation. Having the device positioned correctly may have reminded or encouraged the high tech users to use the device.

Comfort care/need was the most common topic regardless of communication modality use. Two other topics that were common with high tech AAC use and overall were greeting/small talk and patient's condition. Happ, Roesch, and Kagan (2005) also found that patient-nurse communication with post-operative head and neck surgical patients was most commonly about "physical care and comfort needs, such as requests for suction or mouth care, summoning help, or complaints of thirsty." In this study, humor and joking was included in the greeting/small talk category. High tech AAC device use seems to represent a substantive proportion of all communication acts about home and family (20.2%) and emotions (25%) in the sample (See Table 12).

All of the patients used multiple communication modalities; natural communication was used the most. No patient used high tech AAC as their dominant communication modality. This was similar to the results found in two previous studies by Happ, and colleagues (Happ, Roesch, & Kagan, 2005; Happ, Roesch, Garrett, 2004). In these studies, multiple communication modalities were used 94% of the time (45 out of 48 interactions) (Happ, Roesch, & Kagan, 2005) and 70.7% of the time (29 out of 41 interactions) (Happ, Roesch, & Garrett, 2004). Only one patient (n = 10) used the high tech AAC device as the dominant method of communication (Happ, Roesch, & Kagan, 2005).

We chose to include only patients who were physically and cognitively intact in this study. We thought they would provide the best-case scenario of patients that could use high tech AAC. Because these patients were physically intact and most (8/9) had tracheostomies, they were generally able to gesture, nod, and mouth words well. The nurse was frequently able to interpret the patients' natural communication acts. Therefore, these patients did not need to rely on low tech or high tech AAC communication methods to have their message understood. The patients who did use AAC incorporated it into their communication, but still relied heavily on natural communication modalities. AAC was used to a greater extent when the patient was communicating more frequently, but AAC was a small part of the total communication. When an electronic device is available, it does not necessarily become the dominant communication method. In a pilot study of electronic AAC devices, Happ, Roesch, and Kagan (2005) also found that "writing and nonverbal methods (i.e., gestures, head nods, and facial expressions) were most common" (Happ, Roesch, & Kagan, 2005). Writing and gestures are communication methods that are used normally and throughout someone's life. It may be easier for patients to use these because they typically communicate in those ways. Writing and gesturing are comfortable and

natural approaches to communication (Happ, Roesch, & Kagan, 2005). Using high tech AAC in the hospital setting may become more normal and easier for patients as the use of personal communication devices and touch pad devices such as the iPad become more ubiquitous. However, this modality requires usability and acceptability testing in the context of critical illness as well.

### 5.3 RESEARCH QUESTION 2

*How does AAC use change during the two days directly after receiving the device?*

We expected that AAC use would increase over the two-day period as patient-nurse dyads gained practice and comfort with the new electronic equipment available. Instead, there was not a typical pattern of AAC use over time. It varied for each patient, and communication declined for eight out of nine patients during session 4. Variations may occur due to patient factors, device failure or the complexity of the device. In addition, patients may find that they do not need to use the device during every session. As described above, all of the patients used natural communication modalities most frequently and this has been seen in other studies (Happ, Roesch, & Kagan, 2005; Happ, Roesch, & Garrett, 2004). Patients may have only turned to the high tech AAC device when they were unable to communicate effectively with other modalities. While nurses exhibited some behaviors to facilitate AAC tool and device use, it is possible that the nurse training and the SLP intervention was not powerful enough to fully engage or enable patients in effective use of these devices.

In summary, this study supports the literature that natural communication methods are the most commonly used and that patients combine multiple communication techniques such as high

tech AAC with mouthing, gesturing, or writing. This study added to the literature about the topic of communication when high tech AAC is used. The findings confirmed other research that found that comfort/care needs is the most common topic. In addition, this study found that although the topics discussed while using high tech AAC are similar to those in communication with natural communication modalities, communication acts about home and family and emotions may be facilitated by the use of high tech AAC. This study also added to the literature about AAC use during the two days directly after intervention enactment.

#### **5.4 PRACTICE IMPLICATIONS**

It is important for nurses to understand that there is not a typical pattern of AAC use over time and each patient's pattern of and need for AAC tool use is different. Nurses should facilitate patients in the use of multiple communication methods and assist the patient to combine natural communication modalities with other techniques. Suggesting AAC tool use, offering or handing the AAC tools to the patient and positioning the AAC tools or electronic devices so that patients can best reach and use them are simple, effective ways to facilitate AAC use in the clinical setting.

#### **5.5 RESEARCH IMPLICATIONS**

This study only looked at patients who were physically and cognitively intact. Because of this, the patients could gesture and write well. Additional research is needed to examine the

enactment and progression of high tech AAC with patients who have cognitive impairment (e.g, delirium, sedation) or motor impairment (e.g., upper extremity weakness or paralysis). Other areas of further research include looking at the topic of communication with other people besides the nurse, exploring AAC use beyond two days, and examining the role of high tech AAC when breakdowns in communication occur between the patient and the nurse. Although high tech AAC devices do not typically become the dominant communication method for these patients, research on its use by patients in the ICU should continue so that more is learned about how to help these patients communicate most effectively.

## 6.0 CONCLUSION

Although high tech AAC device use did not increase over the two days of observation as predicted, we did learn more about how patients use AAC devices. The typing text to speech high tech AAC device was popular with patients, as well as the direct selection – spell feature of low tech AAC tools. Nurse facilitative behaviors are important for AAC use, especially positioning the device appropriately. Topics for high tech AAC communication is not necessarily different than that of regular communication; however conversations about home and family and emotions may be facilitated by high tech AAC use. The rate of AAC communication acts remained low. This is because patients combine multiple modalities when they communicate, and they use natural communication modalities most frequently. This information regarding how patients use AAC devices will help nurses to better predict their patients' communication needs and to facilitate effective communication.

Studying electronic AAC use within and across cases in the ICU contributes new knowledge about how patients use these devices. This helps nurses to assist their patients in the use of AAC devices in the ICU and to improve the effectiveness of patient communication with electronic communication aids.

## **APPENDIX A**

### **TOPIC DEFINITIONS**

1.	Pain	Expression by patient or assessment by nurse including request for pain medication, <b>(includes anything related to pain medication). Pain also includes hurting and discomfort. The nurse may use the word hurt, such as ‘Are you hurting anywhere right now?’ A grimace may be a visual sign of pain.</b>
2.	Other symptoms (Add comment on specific symptoms)	SOB, nausea/vomiting, thirst, cold, vision problems, dsypnea, fatigue/sleep, <b>tired</b> , itchy, anxiety; expression by patient or assessment by nurse (subjective feeling); not an all inclusive list
3.	Comfort care/needs	Immediate wants/needs (suction/mouth care, eat/drink, blanket, bed positioning, elimination, hygiene, refused care); expression by patient or as determined by nurse. Consider this category of nursing care as “doing for the patient what he/she would for himself/herself do if they were able.” Does not include anything related directly to patient’s condition/medical care. Includes environmental controls, television, radio, room temperature, call light, and patient positioning.
4.	Greeting/Small talk/Social etiquette/Jokes (Add comment if humor)	(Referred to as ‘Social Superficial’ by Ashworth) for example “Hello” or some other social remark which might have been made to anyone and does not specifically relate to the patient as an individual (Ashworth, 1980), <b>includes acknowledging nurse and smiling at nurse. Jokes can be humorous or sarcastic.</b>
5.	Attention getting/Summons for Assistance	eg, “Help,” “I need a nurse now,” sound of an alarm (Rodriguez & Rowe, 2010),
6.	Specific Conversation – extended social conversation	Extended topical discussion not focused directly on individual, discussion of outside events, eg. Steelers, current events.
7.	Home/Family/Friends/Pets/Personal Business	e.g., take money from checking to saving
8.	Patient’s Condition/Tx Plan/Decision Making (Add comment for decision making)	Test/procedures, prognosis, progress, decision-making about care, discharge, request to see the doctor; Decision making: power of attorney, extubation, end of life, etc., <b>includes nurses assessment (How are you feeling today? Are you feeling better?), weaning, and medication administration</b>
9.	Emotional Messages (Use sub-code to describe subject of emotional message – what the patient is worried/scared/angry about)	I love you, Don’t leave me alone, I’m worried, I’m scared, I’m angry, I miss you, I’m sad, I’m <b>disgusted, I’m happy</b> , etc. <b>Emotional messages may be displayed through visual signs of distress or emotions such as a frown or crying.</b>
10.	Communication Aid (Add comment if Vidatak used)	Low tech communication strategies and methods, includes reading glasses, hearing aids, cuff deflation; High tech communication strategies and methods; <b>includes positioning of device, device error, and device teaching.</b>
11.	<b>Repetition of previous topic/utterance/communication act</b>	<b>Repetition by patient of the previous act/previous utterance because patient’s communication was not understood or misinterpreted.</b>
99.	Unable to interpret	Unable to interpret mouthing or nurse is blocking patient’s mouthing and topic cannot be determined.

Additional coding rules:

1. Messages like 'I'm worried' and 'I'm scared' will be coded as Emotional Message (9). A sub-code will be used to describe what the patient is worried about. "I am worried about paying my bills" would be coded as 9 – Emotional Message with a sub-code for 7 – Home/Personal Business. "I am scared about this test" would be coded as 9 – Emotional Message with a sub-code for 8 – Patient's Condition/Tx Plan/Decision Making.

2. When a patient nods 'yes' or 'no' to a question that the nurse has asked, the topic of the patient's response is the topic of the nurse's question. For example, if the nurse asks, "Do you have pain?" the patient's nod can be assumed to mean, "Yes, I have pain." The topic therefore is coded as 1 – pain. If the nurse asks "Would you like the TV on?" and the patient responds by shaking their head no, this would be assumed to mean, "No, I would not like the TV on." This would be coded as 3 – Comfort care/needs. All patients in my study are cognitively intact therefore should be responding to yes/no questions appropriately.

3. Topic is being coded for every patient act. The topic being coded can change within one patient/nurse exchange.

4. In an incidence of "Repetition of previous topic/utterance/communication act," the first act is given the topic code and the repeated acts are coded as 11. It is okay to look through multiple acts to find the topic as long as the patient continues to repeat or expand on the initial misunderstood/misinterpreted act. If the topic is never determined (the nurse and patient do not repair the breakdown), a 99 (Unable to interpret) is used.

5. If the patient mouths something that the video viewer cannot interpret or the nurse is blocking the patient's mouthing, it is not automatically given a 99 (Unable to interpret). If the nurse responds to the patient and there is not a breakdown, the topic is that of the nurse's act (by using the line above and below the patient act). If the patient tries to clarify by repeating their previous utterance, then use coding rule 4.

## **APPENDIX B**

### **LENGTH OF VIDEO SESSIONS**

<b>Patient</b>	<b>Session</b>	<b>Time (minutes:seconds)</b>	<b>Total Time (minutes:seconds)</b>
1	1	4:48	38:43
	2	19:38	
	3	7:25	
	4	6:52	
2	1	6:12	36:38
	2	9:41	
	3	13:55	
	4	6:50	
3	1	5:16	34:48
	2	7:20	
	3	16:45	
	4	5:27	
4	1	18:24	49:28
	2	11:21	
	3	7:09	
	4	12:34	
5	1	4:18	21:58
	2	4:08	
	3	5:41	
	4	7:51	
6	1	7:35	28:17
	2	7:13	
	3	7:17	
	4	6:12	
7	1	7:57	44:20
	2	10:11	
	3	8:13	
	4	17:59	
8	1	7:54	26:55
	2	7:24	
	3	3:47	
	4	7:50	
9	1	5:17	18:48
	2	5:00	
	3	5:06	
	4	3:25	

## **APPENDIX C**

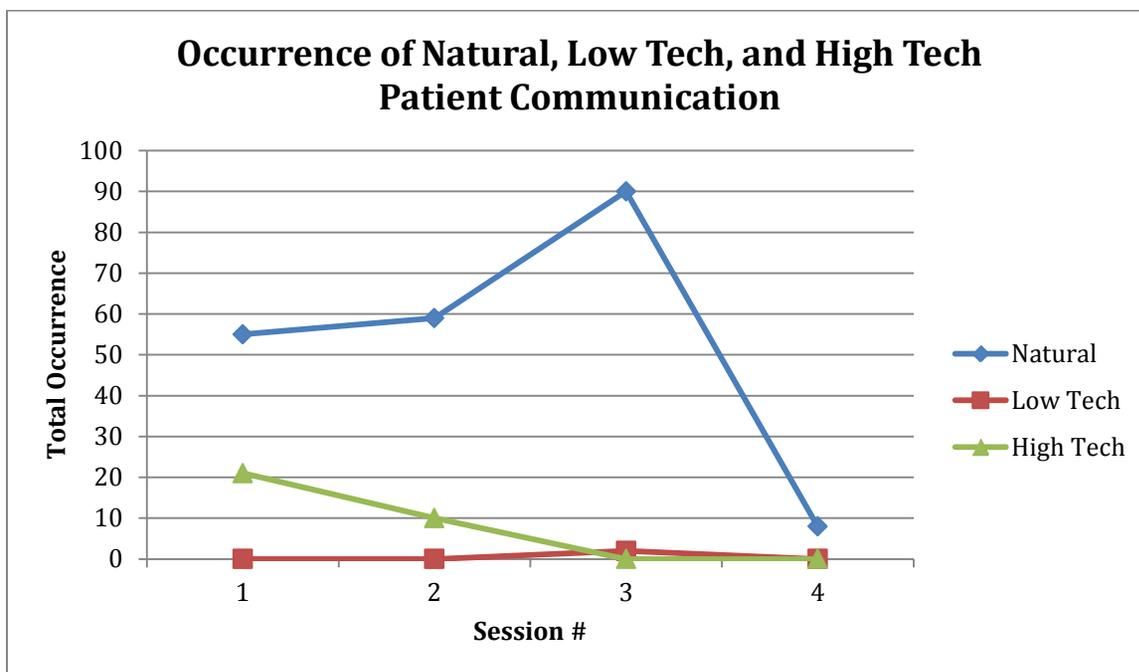
### **PATIENT 1**

I. Topic Occurrence by Session

<b>Topic</b>	<b>Session 1</b>	<b>Session 2</b>	<b>Session 3</b>	<b>Session 4</b>	<b>Total</b>
Pain	0	0	1	0	1
Other Symptoms	2	1	10	1	14
Comfort care/needs	9	19	11	1	40
Greeting/Small talk	4	2	5	2	13
Attention getting	0	0	0	0	0
Specific Conversation	0	0	0	0	0
Home/Family	20	3	18	0	41
Patient's Condition	5	15	13	3	36
Emotional Messages	0	10	0	0	10
Communication Aid	1	0	0	0	1
Repetition of previous topic/utterance/communication act	2	0	0	0	2
Unable to interpret	1	2	0	0	3
<b>Total</b>	<b>44</b>	<b>52</b>	<b>58</b>	<b>7</b>	<b>161</b>

## II. Occurrence of Natural, Low Tech, and High Tech Patient Communication

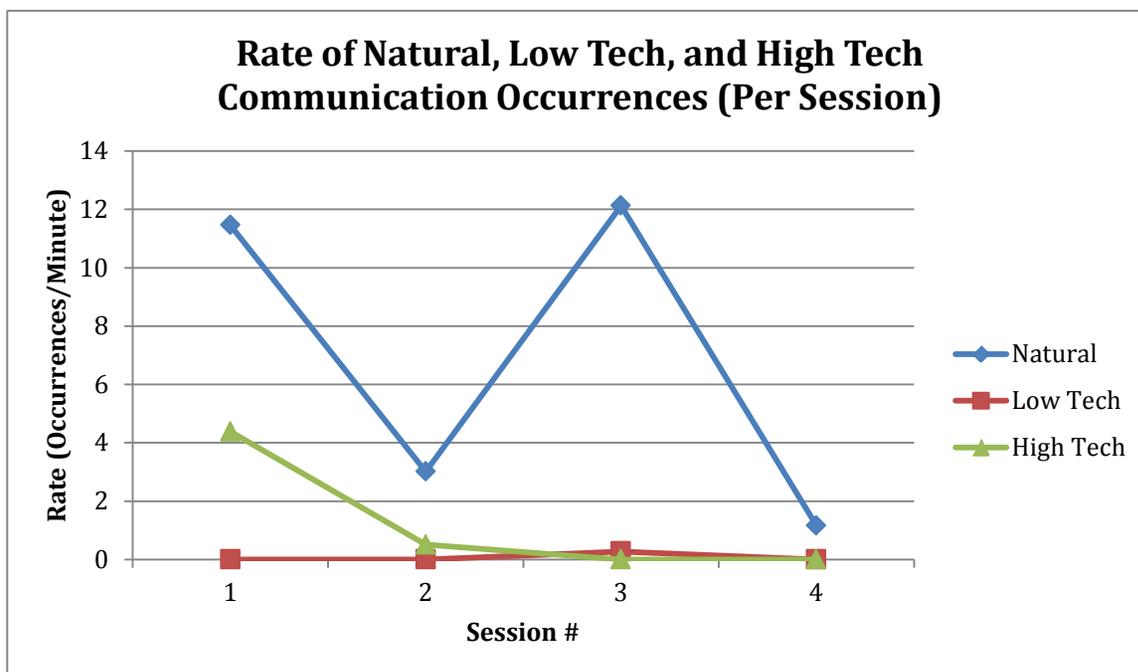
	Natural	Low Tech	High Tech	AAC Total	Total
Session 1	55	0	21	21	76
Session 2	59	0	10	10	69
Session 3	90	2	0	2	92
Session 4	8	0	0	0	8
Total	212	2	31	33	245



\* A patient can use more than 1 natural communication modality or multiple modalities within one communication act.

### III. Rate of Patient Communication (Occurrences Per Minute)

	Natural	Low Tech	High Tech	AAC Total
Session 1	11.46	0	4.38	4.38
Session 2	3.01	0	0.51	0.51
Session 3	12.13	0.27	0	0.27
Session 4	1.16	0	0	0
Mean rates	5.48	0.05	0.80	0.85



\* A patient can use more than 1 natural communication modality or multiple modalities within one communication act.

#### IV. Nurse Facilitative Behaviors

(No nurse facilitative behaviors present with this patient)

	Nurse Low Tech AAC Behaviors/Strategies				Nurse High Tech AAC Behaviors/Strategies			Total
	Uses partner dependent auditory scanning technique	Presents items needed (e.g., clipboard, pen, eye gaze board) for low tech communication	Provides written word choices (auditorially & graphically)	Instructs patient to refer to chart-based encoding strategy/interprets response	Positions device appropriately so that patient can physically access it	Reviews display/potential messages with patient when necessary	Physically assists patient to communicate	
Session 1	0	2	0	0	0	3	1	6
Session 2	0	0	0	0	1	0	1	2
Session 3	0	0	0	1	0	0	0	1
Session 4	0	0	0	0	0	0	0	0
Total	0	2	0	1	1	3	2	9

V. Patient's Natural Communication Modality Use by Session

	Mouthing	Gesture (e.g., waving around the room, pointing, symbolic gestures, social gestures)	Head nod yes/no OR thumbs up/down yes/no	Facial Expression (e.g., smile, frown)	Non-verbal (but communicative) Action (e.g., purposeful looking, purposeful squeeze)	Audible (around trach) vocalization or speech	Total
Session 1	22	0	22	6	5	0	55
Session 2	22	2	31	1	3	0	59
Session 3	40	2	37	8	3	0	90
Session 4	0	0	5	1	2	0	8
Total	84	4	95	16	13	0	212

VI. Patient's Low Tech AAC Use by Session

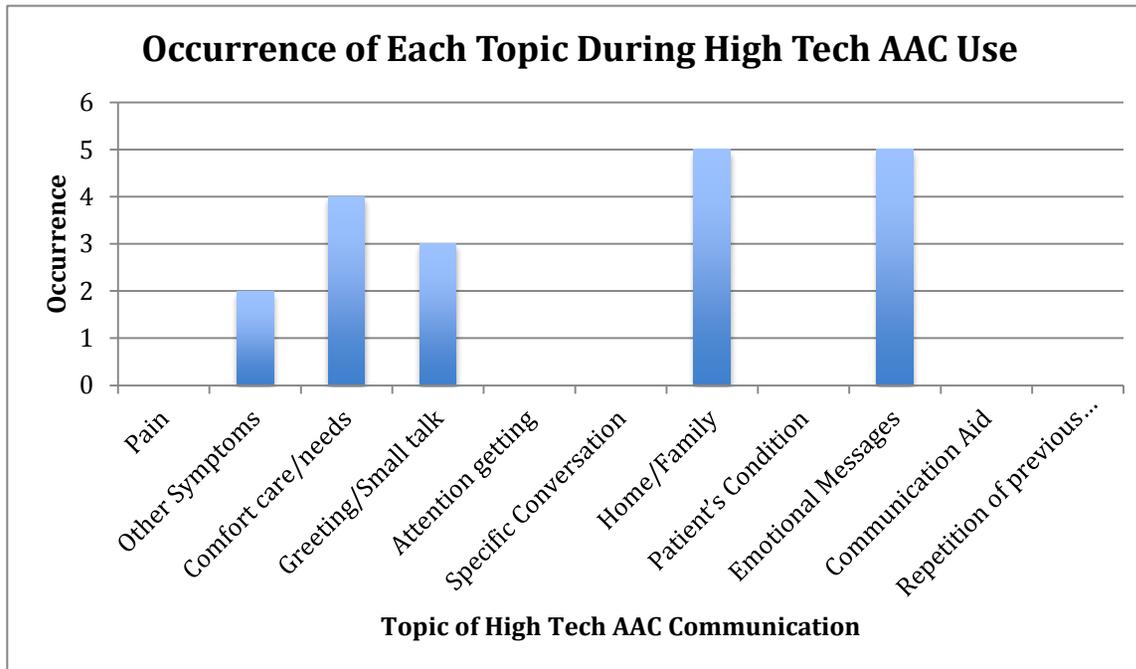
	Session 1	Session 2	Session 3	Session 4	Total
Drawing	0	0	0	0	0
Writing	0	0	0	0	0
Point to partner – generated written word choices	0	0	0	0	0
Point to partner – generated points on a graphic scale	0	0	0	0	0
First letter spelling while mouthing	0	0	0	0	0
Point to alphabet board	0	0	0	2	2
Point to locations on a drawn map	0	0	0	0	0
Point to an encoded symbol representing a phrase	0	0	0	0	0
Indicate letter in response to partner's auditory/visual scanning of alphabet	0	0	0	0	0
Indicate phrase in response to partner's auditory/visual scanning of phrase choice list	0	0	0	0	0

Talking trach valve	0	0	0	0	0
Eye gaze	0	0	0	0	0
Prepares message in advance for nurse caregiver	0		0	0	0
Total	0	0	0	2	2

VII. Patient High Tech AAC Communication Modality Use by Session

	Direct Selection - Spell	Direct Selection – Message (e.g. word, picture, phrase)	Scan – Word, Picture	Scan - Spell	Total
Session 1	21	0	0	0	21
Session 2	10	0	0	0	10
Session 3	0	0	0	0	0
Session 4	0	0	0	0	0
Total	31	0	0	0	31

### VIII. Topic of High Tech AAC Communication



IX. AAC Communication Acts (includes both low and high tech)

	# of patient communication acts	# of AAC acts	# of AAC acts in first 3 minutes (rate = n/3)	# of AAC acts after first 3 minutes (rate = n/x)
Session 1	44	21	14 (4.67)	7 (3.89)
Session 2	59	10	2 (0.67)	8 (0.48)
Session 3	60	2	0	2 (0.45)
Session 4	7	0	0	0
Totals	170	33	16 (1.33)	17 (0.64)

n = number of acts

x = length of remaining video (after 3 minutes)

**APPENDIX D**

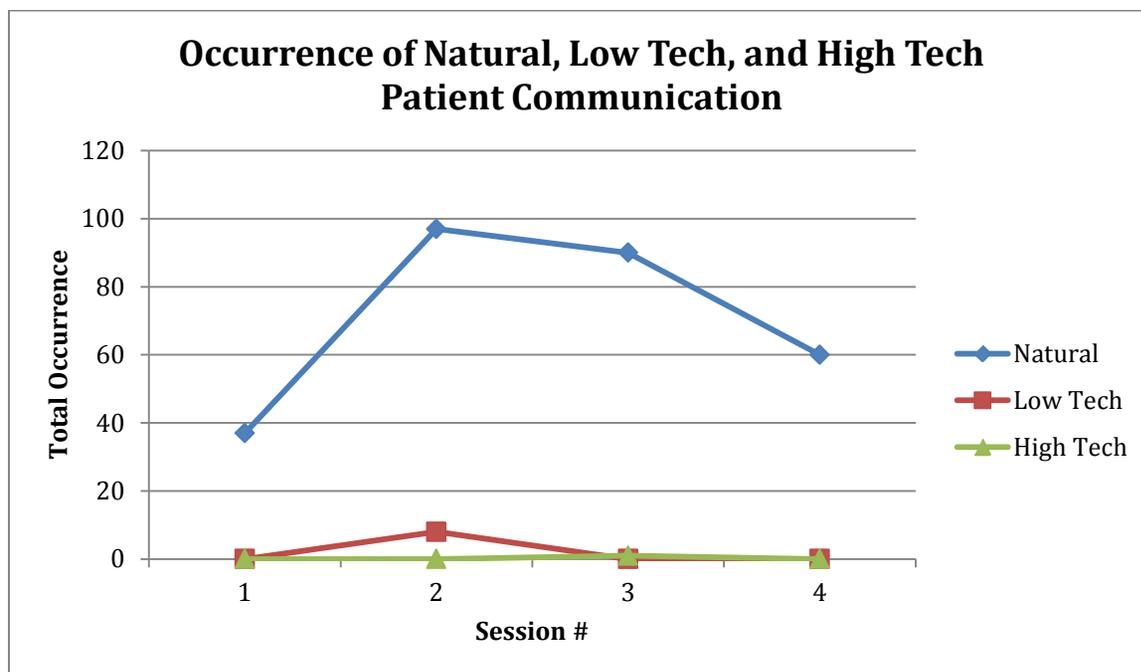
**PATIENT 2**

I. Topic Occurrence by Session

<b>Topic</b>	<b>Session 1</b>	<b>Session 2</b>	<b>Session 3</b>	<b>Session 4</b>	<b>Total</b>
Pain	0	1	2	2	5
Other Symptoms	0	0	3	2	5
Comfort care/needs	1	39	26	24	90
Greeting/Small talk	14	4	13	2	33
Attention getting	0	0	0	0	0
Specific Conversation	0	0	0	0	0
Home/Family	0	0	2	0	2
Patient's Condition	0	24	23	7	54
Emotional Messages	0	0	0	0	0
Communication Aid	0	4	8	0	12
Repetition of previous topic/utterance/communication act	0	4	2	0	6
Unable to interpret	0	0	0	3	3
<b>Total</b>	<b>15</b>	<b>76</b>	<b>79</b>	<b>40</b>	<b>210</b>

## II. Occurrence of Natural, Low Tech, and High Tech Patient Communication

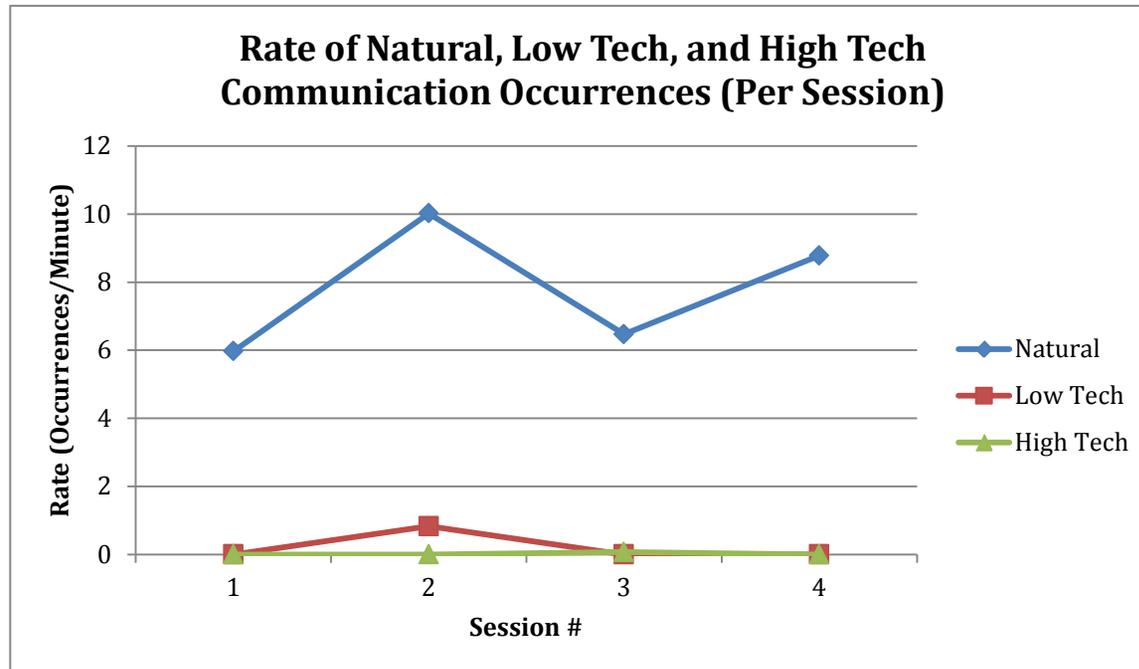
	Natural	Low Tech	High Tech	AAC Total	Total
Session 1	37	0	0	0	37
Session 2	97	8	0	8	105
Session 3	90	0	1	1	91
Session 4	60	0	0	0	60
Total	284	8	1	9	293



\* A patient can use more than 1 natural communication modality or multiple modalities within one communication act.

### III. Rate of Patient Communication (Occurrences Per Minute)

	Natural	Low Tech	High Tech	AAC Total
Session 1	5.97	0	0	0
Session 2	10.02	0.83	0	0.83
Session 3	6.47	0	0.07	0.07
Session 4	8.78	0	0	0
Mean rates	7.81	0.21	0.02	0.23



\* A patient can use more than 1 natural communication modality or multiple modalities within one communication act.

#### IV. Nurse Facilitative Behaviors

	Nurse Low Tech AAC Behaviors/Strategies				Nurse High Tech AAC Behaviors/Strategies			Total
	Uses partner dependent auditory scanning technique	Presents items needed (e.g., clipboard, pen, eye gaze board) for low tech communication	Provides written word choices (auditorially & graphically)	Instructs patient to refer to chart-based encoding strategy/interprets response	Positions device appropriately so that patient can physically access it	Reviews display/potential messages with patient when necessary	Physically assists patient to communicate	
Session 1	0	0	0	0	0	0	0	0
Session 2	0	2	0	0	0	0	0	2
Session 3	0	0	0	0	1	0	0	1
Session 4	0	0	0	0	0	0	0	0
Total	0	2	0	0	1	0	0	3

V. Patient's Natural Communication Modality Use by Session

	Mouthing	Gesture (e.g., waving around the room, pointing, symbolic gestures, social gestures)	Head nod yes/no OR thumbs up/down yes/no	Facial Expression (e.g., smile, frown)	Non-verbal (but communicative) Action (e.g., purposeful looking, purposeful squeeze)	Audible (around trach) vocalization or speech	Total
Session 1	0	0	13	10	14	0	37
Session 2	18	16	41	3	19	0	97
Session 3	8	13	48	12	9	0	90
Session 4	14	13	17	3	13	0	60
Total	40	42	119	28	55	0	284

VI. Patient's Low Tech AAC Use by Session

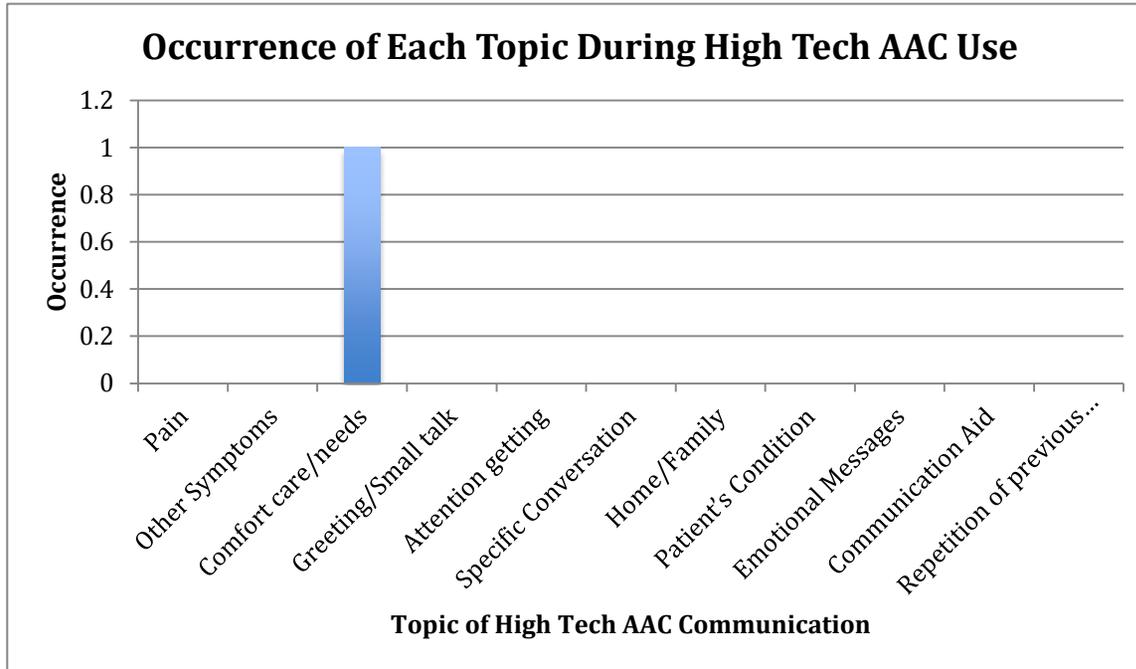
	Session 1	Session 2	Session 3	Session 4	Total
Drawing	0	0	0	0	0
Writing	0	4	0	0	4
Point to partner – generated written word choices	0	0	0	0	0
Point to partner – generated points on a graphic scale	0	0	0	0	0
First letter spelling while mouthing	0	0	0	0	0
Point to alphabet board	0	4	0	0	4
Point to locations on a drawn map	0	0	0	0	0
Point to an encoded symbol representing a phrase	0	0	0	0	0
Indicate letter in response to partner's auditory/visual scanning of alphabet	0	0	0	0	0
Indicate phrase in response to partner's auditory/visual scanning of phrase choice list	0	0	0	0	0

Talking trach valve	0	0	0	0	0
Eye gaze	0	0	0	0	0
Prepares message in advance for nurse caregiver	0		0	0	0
Total	0	8	0	0	8

VII. Patient High Tech AAC Communication Modality Use by Session

	Direct Selection - Spell	Direct Selection – Message (e.g. word, picture, phrase)	Scan – Word, Picture	Scan - Spell	Total
Session 1	0	0	0	0	0
Session 2	0	0	0	0	0
Session 3	0	0	0	1	1
Session 4	0	0	0	0	0
Total	0	0	0	1	1

### VIII. Topic of High Tech AAC Communication



IX. AAC Communication Acts (includes both low and high tech)

	# of patient communication acts	# of AAC acts	# of AAC acts in first 3 minutes (rate = n/3)	# of AAC acts after first 3 minutes (rate = n/x)
Session 1	15	0	0	0
Session 2	76	8	4 (1.33)	4 (0.60)
Session 3	79	1	0	1 (0.09)
Session 4	40	0	0	0
Totals	210	9	4 (0.33)	5 (0.20)

n = number of acts

x = length of remaining video (after 3 minutes)

**APPENDIX E**

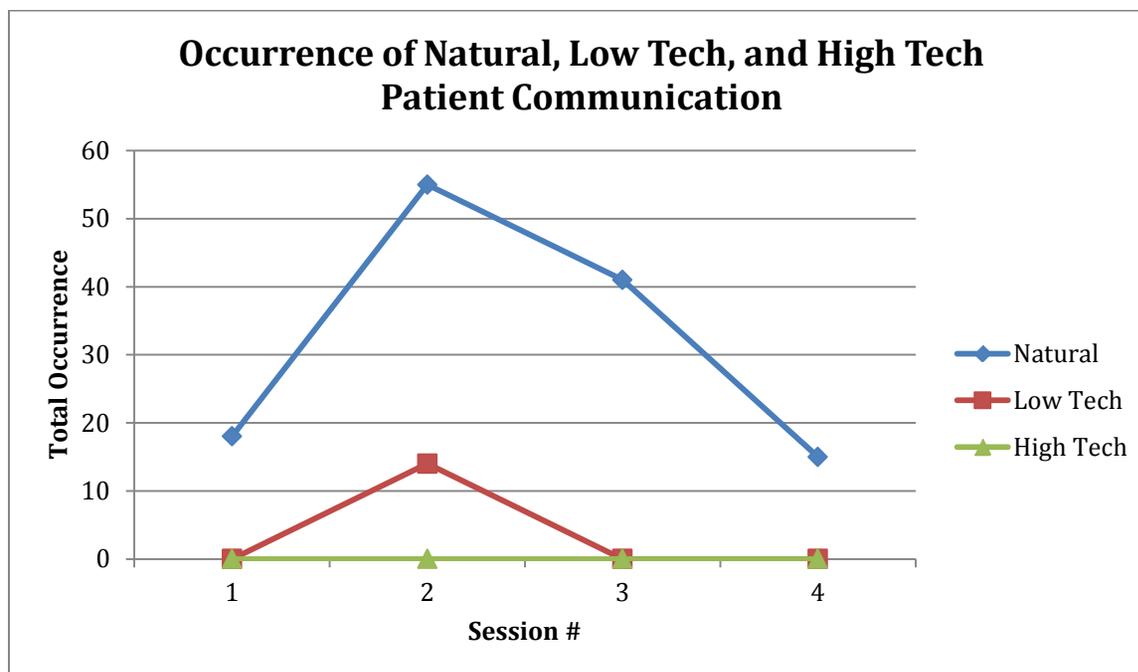
**PATIENT 3**

I. Topic Occurrence by Session

<b>Topic</b>	<b>Session 1</b>	<b>Session 2</b>	<b>Session 3</b>	<b>Session 4</b>	<b>Total</b>
Pain	3	13	0	7	23
Other Symptoms	0	0	1	0	1
Comfort care/needs	0	2	16	4	22
Greeting/Small talk	0	2	3	0	5
Attention getting	0	2	0	0	2
Specific Conversation	0	0	0	0	0
Home/Family	6	0	0	0	6
Patient's Condition	2	30	2	1	35
Emotional Messages	0	0	7	0	7
Communication Aid	0	1	0	0	1
Repetition of previous topic/utterance/communication act	2	2	0	1	5
Unable to interpret	1	0	1	0	2
<b>Total</b>	<b>14</b>	<b>52</b>	<b>30</b>	<b>13</b>	<b>109</b>

## II. Occurrence of Natural, Low Tech, and High Tech Patient Communication

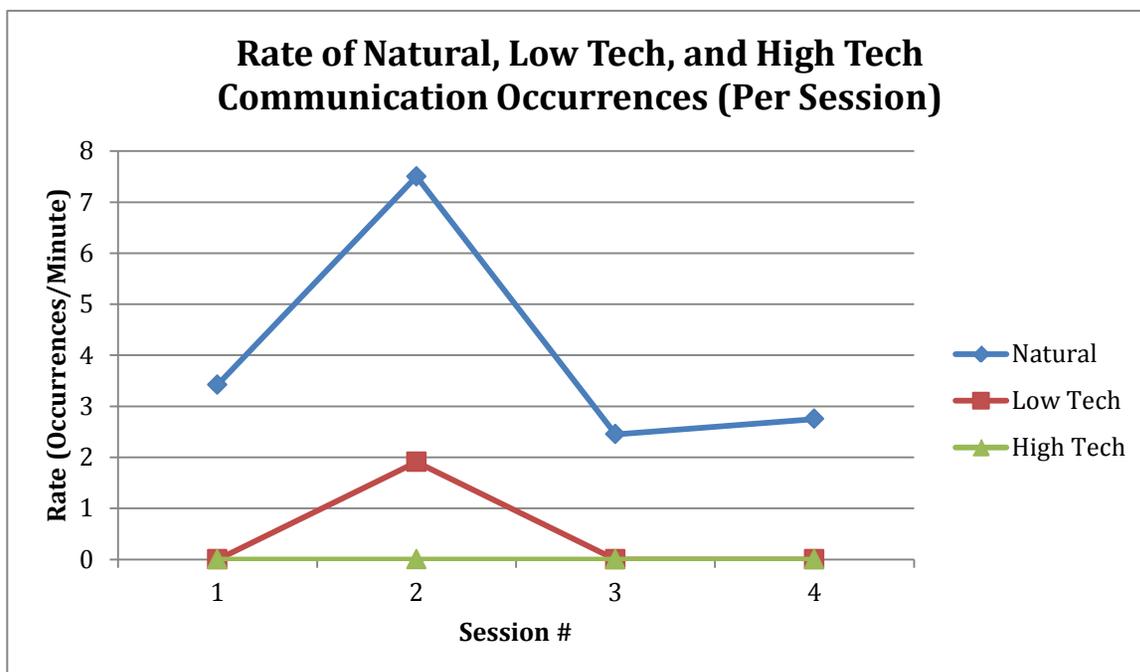
	Natural	Low Tech	High Tech	AAC Total	Total
Session 1	18	0	0	0	18
Session 2	55	14	0	14	69
Session 3	41	0	0	0	41
Session 4	15	0	0	0	15
Total	129	14	0	14	143



\* A patient can use more than 1 natural communication modality or multiple modalities within one communication act.

### III. Rate of Patient Communication (Occurrences Per Minute)

	Natural	Low Tech	High Tech	AAC Total
Session 1	3.42	0	0	0
Session 2	7.50	1.91	0	1.91
Session 3	2.45	0	0	0
Session 4	2.75	0	0	0
Mean rates	4.03	0.48	0	0.48



\* A patient can use more than 1 natural communication modality or multiple modalities within one communication act.

#### IV. Nurse Facilitative Behaviors

	Nurse Low Tech AAC Behaviors/Strategies				Nurse High Tech AAC Behaviors/Strategies			Total
	Uses partner dependent auditory scanning technique	Presents items needed (e.g., clipboard, pen, eye gaze board) for low tech communication	Provides written word choices (auditorially & graphically)	Instructs patient to refer to chart-based encoding strategy/interprets response	Positions device appropriately so that patient can physically access it	Reviews display/potential messages with patient when necessary	Physically assists patient to communicate	
Session 1	0	0	0	0	0	0	0	0
Session 2	0	0	0	0	0	0	2	2
Session 3	0	0	0	0	1	0	0	1
Session 4	0	0	0	0	0	0	0	0
Total	0	0	0	0	1	0	2	3

V. Patient's Natural Communication Modality Use by Session

	Mouthing	Gesture (e.g., waving around the room, pointing, symbolic gestures, social gestures)	Head nod yes/no OR thumbs up/down yes/no	Facial Expression (e.g., smile, frown)	Non-verbal (but communicative) Action (e.g., purposeful looking, purposeful squeeze)	Audible (around trach) vocalization or speech	Total
Session 1	8	4	6	0	0	0	18
Session 2	13	9	26	1	6	0	55
Session 3	7	2	21	7	4	0	41
Session 4	4	0	10	0	1	0	15
Total	32	15	63	8	11	0	129

VI. Patient's Low Tech AAC Use by Session

	Session 1	Session 2	Session 3	Session 4	Total
Drawing	0	0	0	0	0
Writing	0	6	0	0	6
Point to partner – generated written word choices	0	0	0	0	0
Point to partner – generated points on a graphic scale	0	0	0	0	0
First letter spelling while mouthing	0	0	0	0	0
Point to alphabet board	0	8	0	0	8
Point to locations on a drawn map	0	0	0	0	0
Point to an encoded symbol representing a phrase	0	0	0	0	0
Indicate letter in response to partner's auditory/visual scanning of alphabet	0	0	0	0	0
Indicate phrase in response to partner's auditory/visual scanning of phrase choice list	0	0	0	0	0

Talking trach valve	0	0	0	0	0
Eye gaze	0	0	0	0	0
Prepares message in advance for nurse caregiver	0		0	0	0
Total	0	14	0	0	14

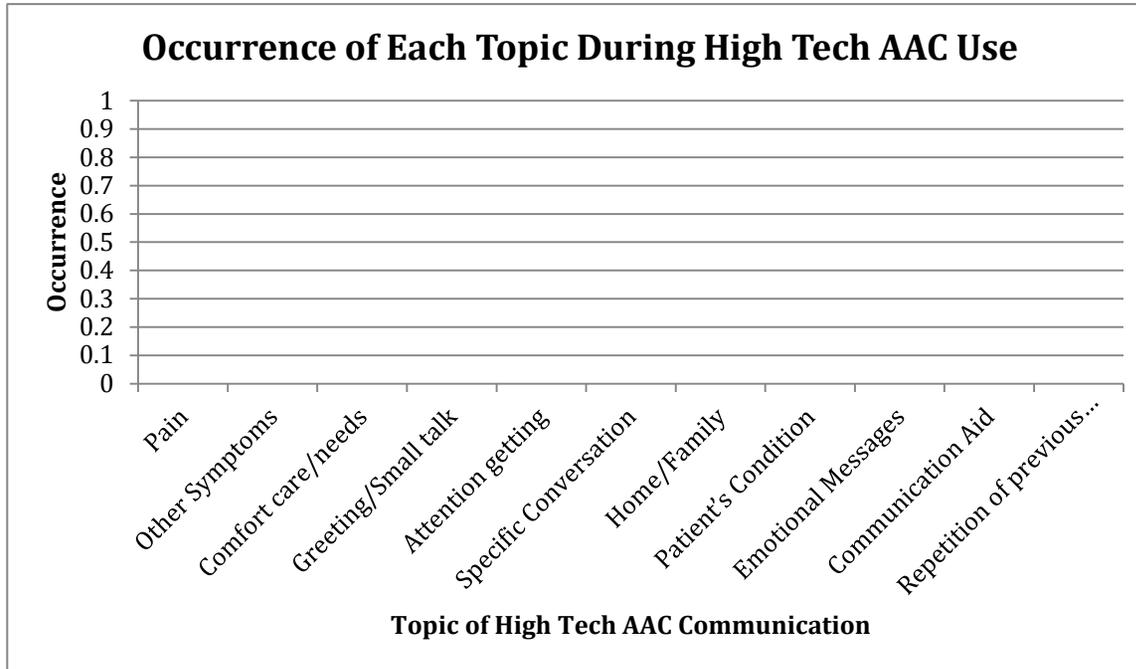
### VII. Patient High Tech AAC Communication Modality Use by Session

(This patient did not use high tech AAC use)

	Direct Selection - Spell	Direct Selection – Message (e.g. word, picture, phrase)	Scan – Word, Picture	Scan - Spell	Total
Session 1	0	0	0	0	0
Session 2	0	0	0	0	0
Session 3	0	0	0	0	0
Session 4	0	0	0	0	0
Total	0	0	0	0	0

### VIII. Topic of High Tech AAC Communication

(This patient did not use high tech AAC)



IX. AAC Communication Acts (includes both low and high tech)

	# of patient communication acts	# of AAC acts	# of AAC acts in first 3 minutes (rate = n/3)	# of AAC acts after first 3 minutes (rate = n/x)
Session 1	14	0	0	0
Session 2	52	14	8 (2.67)	6 (1.39)
Session 3	30	0	0	0
Session 4	13	0	0	0
Totals	109	14	8 (0.67)	6 (0.26)

n = number of acts

x = length of remaining video (after 3 minutes)

**APPENDIX F**

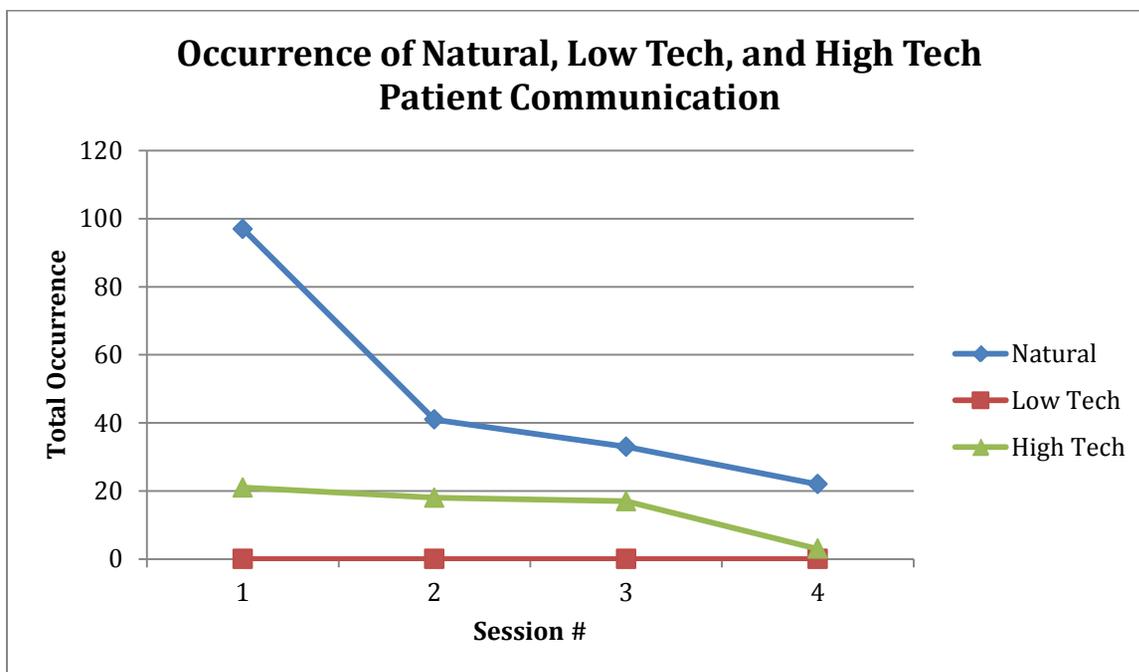
**PATIENT 4**

I. Topic Occurrence by Session

<b>Topic</b>	<b>Session 1</b>	<b>Session 2</b>	<b>Session 3</b>	<b>Session 4</b>	<b>Total</b>
Pain	0	0	0	0	0
Other Symptoms	0	2	0	0	2
Comfort care/needs	51	16	3	7	77
Greeting/Small talk	19	5	1	2	27
Attention getting	0	0	0	0	0
Specific Conversation	1	11	0	0	12
Home/Family	1	2	21	6	30
Patient's Condition	23	13	14	7	57
Emotional Messages	0	0	0	1	1
Communication Aid	2	0	0	3	5
Repetition of previous topic/utterance/communication act	0	0	1	0	1
Unable to interpret	0	0	1	0	1
<b>Total</b>	<b>97</b>	<b>49</b>	<b>41</b>	<b>26</b>	<b>213</b>

## II. Occurrence of Natural, Low Tech, and High Tech Patient Communication

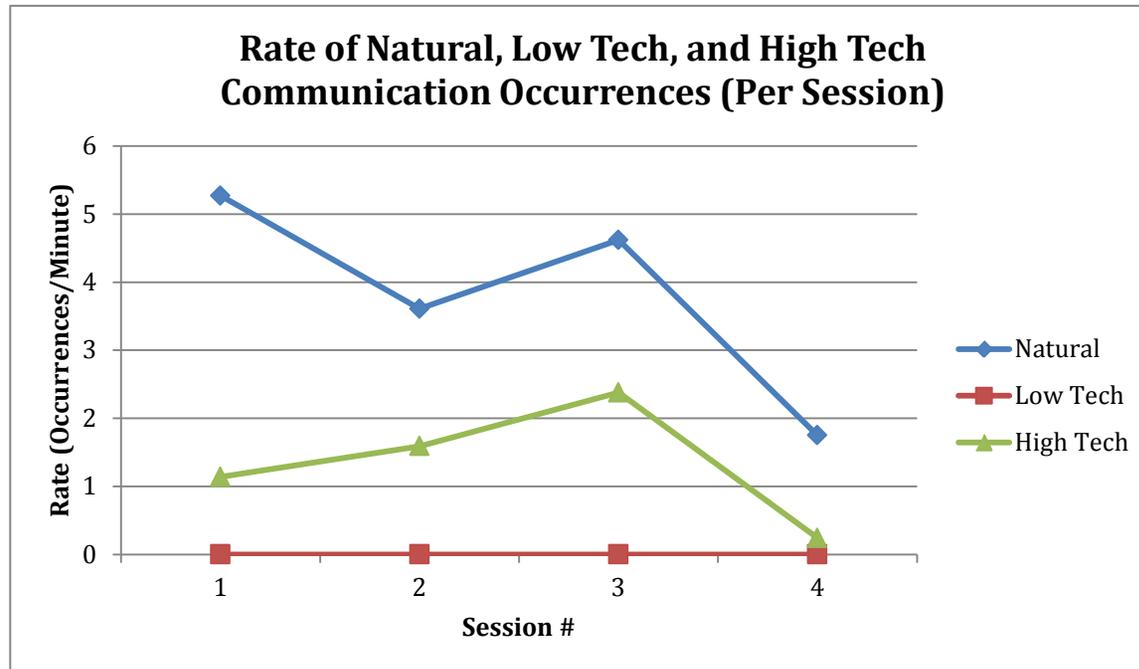
	Natural	Low Tech	High Tech	AAC Total	Total
Session 1	97	0	21	21	118
Session 2	41	0	18	18	59
Session 3	33	0	17	17	50
Session 4	22	0	3	3	25
Total	193	0	59	59	252



\* A patient can use more than 1 natural communication modality or multiple modalities within one communication act.

### III. Rate of Patient Communication (Occurrences Per Minute)

	Natural	Low Tech	High Tech	AAC Total
Session 1	5.27	0	1.14	1.14
Session 2	3.61	0	1.59	1.59
Session 3	4.62	0	2.38	2.38
Session 4	1.75	0	0.24	0.24
Mean rates	3.81	0	1.34	1.34



\* A patient can use more than 1 natural communication modality or multiple modalities within one communication act.

#### IV. Nurse Facilitative Behaviors

	Nurse Low Tech AAC Behaviors/Strategies				Nurse High Tech AAC Behaviors/Strategies			Total
	Uses partner dependent auditory scanning technique	Presents items needed (e.g., clipboard, pen, eye gaze board) for low tech communication	Provides written word choices (auditorially & graphically)	Instructs patient to refer to chart-based encoding strategy/interprets response	Positions device appropriately so that patient can physically access it	Reviews display/potential messages with patient when necessary	Physically assists patient to communicate	
Session 1	0	0	0	0	2	0	0	2
Session 2	0	0	0	0	0	0	0	0
Session 3	0	0	0	0	0	0	0	0
Session 4	0	0	0	0	0	0	0	0
Total	0	0	0	0	2	0	0	2

V. Patient's Natural Communication Modality Use by Session

	Mouthing	Gesture (e.g., waving around the room, pointing, symbolic gestures, social gestures)	Head nod yes/no OR thumbs up/down yes/no	Facial Expression (e.g., smile, frown)	Non-verbal (but communicative) Action (e.g., purposeful looking, purposeful squeeze)	Audible (around trach) vocalization or speech	Total
Session 1	1	12	59	15	10	0	97
Session 2	1	2	32	4	2	0	41
Session 3	0	4	26	2	1	0	33
Session 4	0	7	10	3	2	0	22
Total	2	25	127	24	15	0	193

## VI. Patient's Low Tech AAC Use by Session

(No low tech AAC used)

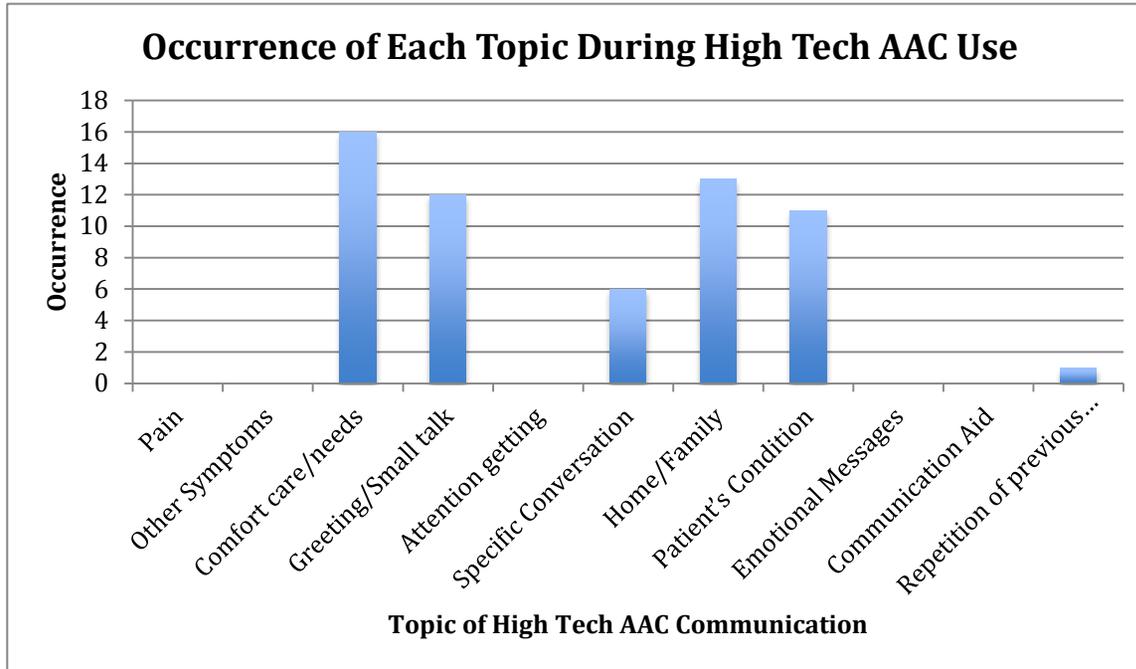
	Session 1	Session 2	Session 3	Session 4	Total
Drawing	0	0	0	0	0
Writing	0	0	0	0	0
Point to partner – generated written word choices	0	0	0	0	0
Point to partner – generated points on a graphic scale	0	0	0	0	0
First letter spelling while mouthing	0	0	0	0	0
Point to alphabet board	0	0	0	0	0
Point to locations on a drawn map	0	0	0	0	0
Point to an encoded symbol representing a phrase	0	0	0	0	0
Indicate letter in response to partner's auditory/visual scanning of alphabet	0	0	0	0	0
Indicate phrase in response to partner's auditory/visual scanning of phrase choice list	0	0	0	0	0

Talking trach valve	0	0	0	0	0
Eye gaze	0	0	0	0	0
Prepares message in advance for nurse caregiver	0		0	0	0
Total	0	0	3	0	

VII. Patient High Tech AAC Communication Modality Use by Session

	Direct Selection - Spell	Direct Selection – Message (e.g. word, picture, phrase)	Scan – Word, Picture	Scan - Spell	Total
Session 1	21	0	0	0	21
Session 2	18	0	0	0	18
Session 3	17	0	0	0	17
Session 4	3	0	0	0	3
Total	59	0	0	0	59

### VIII. Topic of High Tech AAC Communication



IX. AAC Communication Acts (includes both low and high tech)

	# of patient communication acts	# of AAC acts	# of AAC acts in first 3 minutes (rate = n/3)	# of AAC acts after first 3 minutes (rate = n/x)
Session 1	97	21	8 (2.67)	13 (0.84)
Session 2	49	18	11 (3.67)	7 (0.84)
Session 3	41	17	6 (2.0)	11 (2.65)
Session 4	26	3	0	3 (0.31)
Totals	213	59	25 (2.08)	34 (0.91)

n = number of acts

x = length of remaining video (after 3 minutes)

**APPENDIX G**

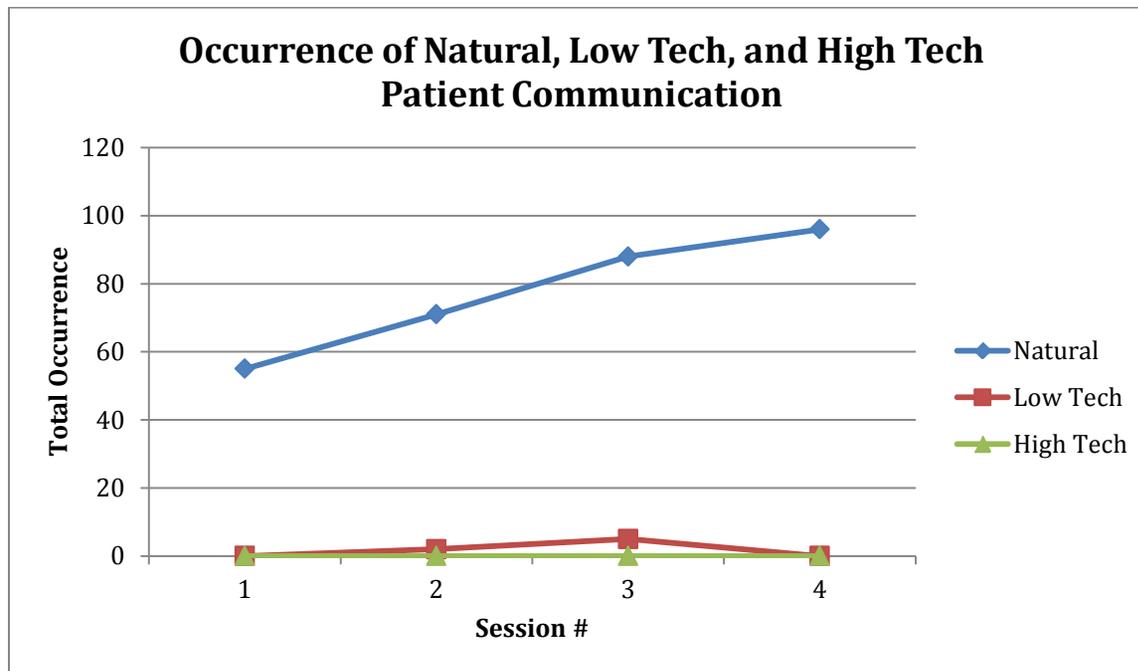
**PATIENT 5**

I. Topic Occurrence by Session

<b>Topic</b>	<b>Session 1</b>	<b>Session 2</b>	<b>Session 3</b>	<b>Session 4</b>	<b>Total</b>
Pain	0	0	0	2	2
Other Symptoms	1	7	0	3	11
Comfort care/needs	17	2	44	11	74
Greeting/Small talk	4	9	8	18	39
Attention getting	0	0	1	1	2
Specific Conversation	0	10	0	2	12
Home/Family	0	1	0	6	7
Patient's Condition	0	11	1	16	28
Emotional Messages	0	1	0	0	1
Communication Aid	0	3	1	0	4
Repetition of previous topic/utterance/communication act	1	2	0	0	3
Unable to interpret	1	0	0	0	1
<b>Total</b>	<b>24</b>	<b>46</b>	<b>55</b>	<b>59</b>	<b>184</b>

## II. Occurrence of Natural, Low Tech, and High Tech Patient Communication

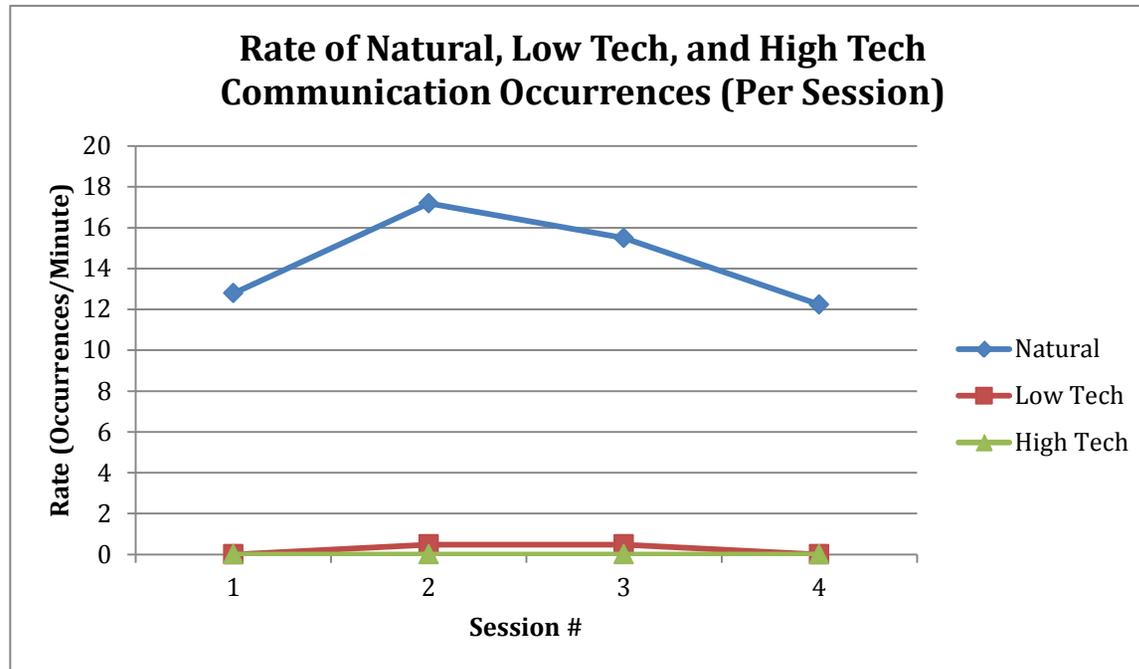
	Natural	Low Tech	High Tech	AAC Total	Total
Session 1	55	0	0	0	55
Session 2	71	2	0	2	73
Session 3	88	5	0	5	93
Session 4	96	0	0	0	96
Total	310	7	0	7	317



\* A patient can use more than 1 natural communication modality or multiple modalities within one communication act.

### III. Rate of Patient Communication (Occurrences Per Minute)

	Natural	Low Tech	High Tech	AAC Total
Session 1	12.79	0	0	0
Session 2	17.19	0.48	0	0.48
Session 3	15.49	0.88	0	0.88
Session 4	12.23	0	0	0
Mean rates	14.43	0.34	0	0.34



\* A patient can use more than 1 natural communication modality or multiple modalities within one communication act.

#### IV. Nurse Facilitative Behaviors

(No nurse facilitative behaviors present with this patient)

	Nurse Low Tech AAC Behaviors/Strategies				Nurse High Tech AAC Behaviors/Strategies			Total
	Uses partner dependent auditory scanning technique	Presents items needed (e.g., clipboard, pen, eye gaze board) for low tech communication	Provides written word choices (auditorially & graphically)	Instructs patient to refer to chart-based encoding strategy/interprets response	Positions device appropriately so that patient can physically access it	Reviews display/potential messages with patient when necessary	Physically assists patient to communicate	
Session 1	0	0	0	0	0	0	0	0
Session 2	0	0	0	0	0	0	0	0
Session 3	0	0	0	0	0	0	0	0
Session 4	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0

V. Patient's Natural Communication Modality Use by Session

	Mouthing	Gesture (e.g., waving around the room, pointing, symbolic gestures, social gestures)	Head nod yes/no OR thumbs up/down yes/no	Facial Expression (e.g., smile, frown)	Non-verbal (but communicative) Action (e.g., purposeful looking, purposeful squeeze)	Audible (around trach) vocalization or speech	Total
Session 1	18	13	15	6	3	0	55
Session 2	30	14	13	9	5	0	71
Session 3	41	20	20	5	2	0	88
Session 4	36	13	26	20	1	0	96
Total	125	60	74	40	11	0	310

VI. Patient's Low Tech AAC Use by Session

	Session 1	Session 2	Session 3	Session 4	Total
Drawing	0	0	0	0	0
Writing	0	2	0	0	2
Point to partner – generated written word choices	0	0	0	0	0
Point to partner – generated points on a graphic scale	0	0	0	0	0
First letter spelling while mouthing	0	0	0	0	0
Point to alphabet board	0	0	5	0	5
Point to locations on a drawn map	0	0	0	0	0
Point to an encoded symbol representing a phrase	0	0	0	0	0
Indicate letter in response to partner's auditory/visual scanning of alphabet	0	0	0	0	0
Indicate phrase in response to partner's auditory/visual scanning of phrase choice list	0	0	0	0	0

Talking trach valve	0	0	0	0	0
Eye gaze	0	0	0	0	0
Prepares message in advance for nurse caregiver	0		0	0	0
Total	0	2	5	0	7

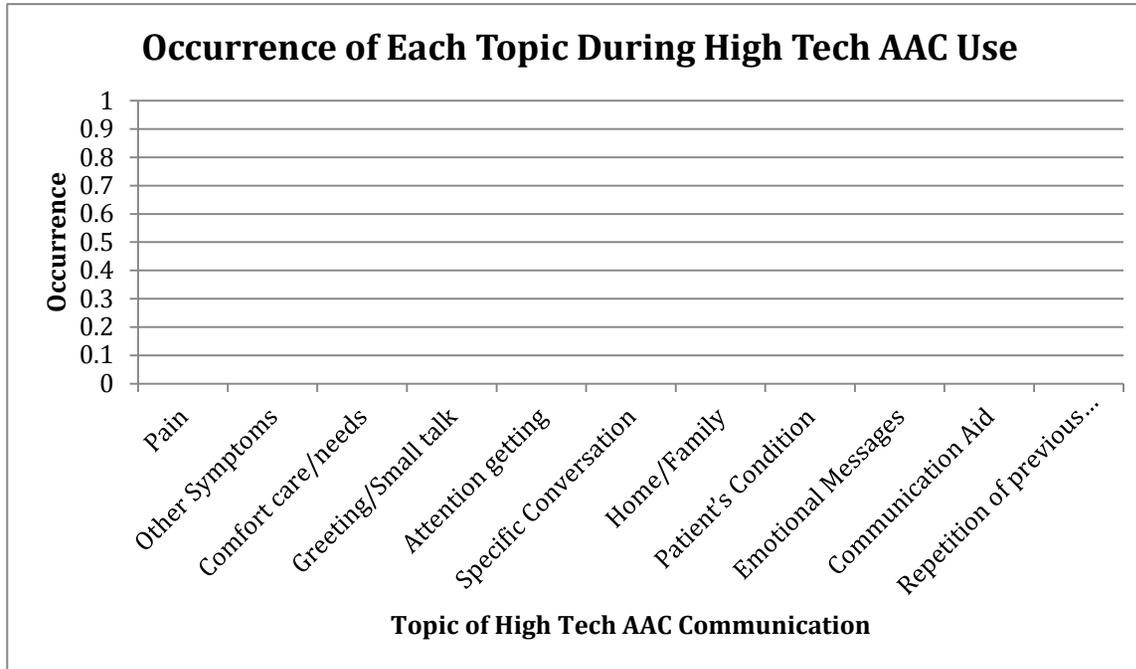
### VII. Patient High Tech AAC Communication Modality Use by Session

(No high tech AAC communication use in this session)

	Direct Selection - Spell	Direct Selection – Message (e.g. word, picture, phrase)	Scan – Word, Picture	Scan - Spell	Total
Session 1	0	0	0	0	0
Session 2	0	0	0	0	0
Session 3	0	0	0	0	0
Session 4	0	0	0	0	0
Total	0	0	0	0	0

### VIII. Topic of High Tech AAC Communication

(No high tech AAC communication use in this session)



IX. AAC Communication Acts (includes both low and high tech)

	# of patient communication acts	# of AAC acts	# of AAC acts in first 3 minutes (rate = n/3)	# of AAC acts after first 3 minutes (rate = n/x)
Session 1	24	0	0	0
Session 2	46	2	2 (0.67)	0
Session 3	55	5	0	5 (1.87)
Session 4	59	0	0	0
Totals	184	7	2 (0.17)	5 (0.50)

n = number of acts

x = length of remaining video (after 3 minutes)

**APPENDIX H**

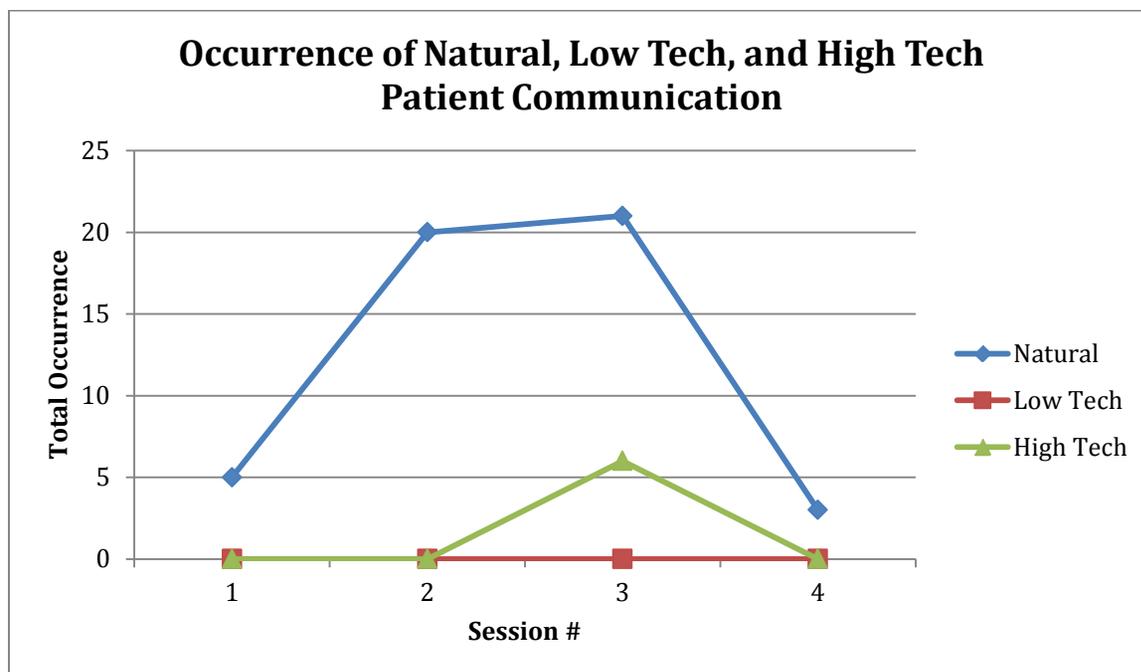
**PATIENT 6**

I. Topic Occurrence by Session

<b>Topic</b>	<b>Session 1</b>	<b>Session 2</b>	<b>Session 3</b>	<b>Session 4</b>	<b>Total</b>
Pain	0	1	1	1	3
Other Symptoms	0	1	2	0	3
Comfort care/needs	1	5	7	1	14
Greeting/Small talk	2	1	1	0	4
Attention getting	0	0	0	0	0
Specific Conversation	0	0	0	0	0
Home/Family	0	5	4	0	9
Patient's Condition	2	3	4	1	10
Emotional Messages	0	0	0	0	0
Communication Aid	0	3	2	0	5
Repetition of previous topic/utterance/communication act	0	0	0	0	0
Unable to interpret	0	0	0	0	0
<b>Total</b>	<b>5</b>	<b>19</b>	<b>21</b>	<b>3</b>	<b>48</b>

## II. Occurrence of Natural, Low Tech, and High Tech Patient Communication

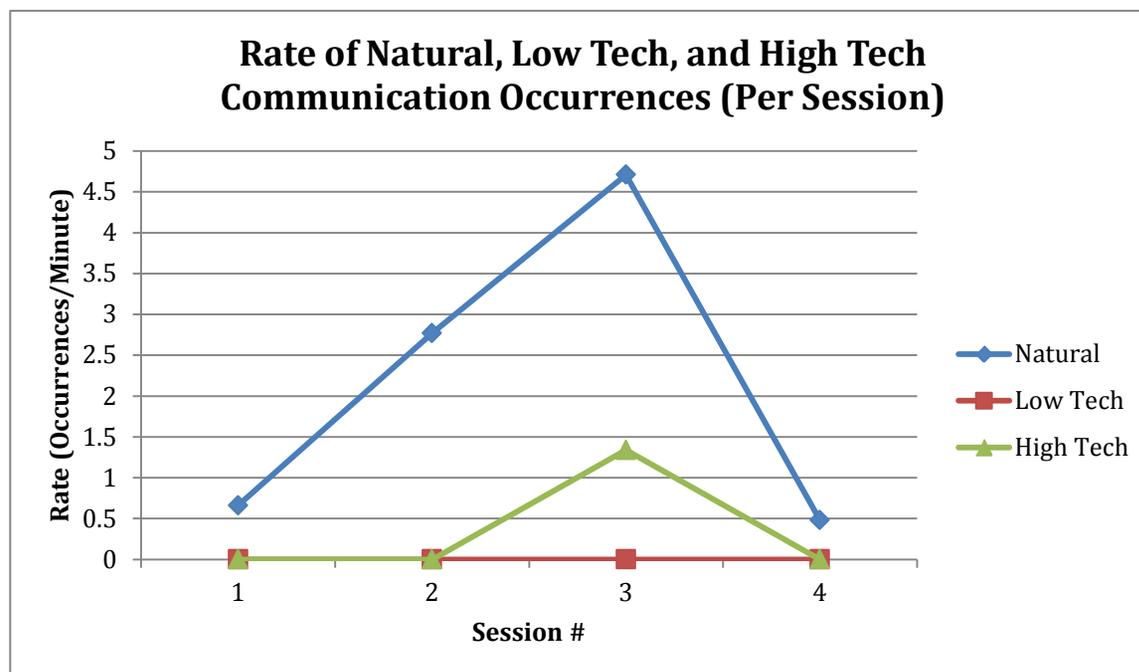
	Natural	Low Tech	High Tech	AAC Total	Total
Session 1	5	0	0	0	5
Session 2	20	0	0	0	20
Session 3	21	0	6	6	27
Session 4	3	0	0	0	3
Total	49	0	6	6	55



\* A patient can use more than 1 natural communication modality or multiple modalities within one communication act.

### III. Rate of Patient Communication (Occurrences Per Minute)

	Natural	Low Tech	High Tech	AAC Total
Session 1	0.66	0	0	0
Session 2	2.77	0	0	0
Session 3	4.71	0	1.34	1.34
Session 4	0.48	0	0	0
Mean rates	2.16	0	0.34	0.34



\* A patient can use more than 1 natural communication modality or multiple modalities within one communication act.

#### IV. Nurse Facilitative Behaviors

	Nurse Low Tech AAC Behaviors/Strategies				Nurse High Tech AAC Behaviors/Strategies		Total
	Uses partner dependent auditory scanning technique	Presents items needed (e.g., clipboard, pen, eye gaze board) for low tech communication	Provides written word choices (auditorially & graphically)	Instructs patient to refer to chart-based encoding strategy/interprets response	Positions device appropriately so that patient can physically access it	Reviews display/potential messages with patient when necessary	
Session 1	0	0	0	0	0	0	0
Session 2	0	0	0	0	0	0	0
Session 3	0	0	0	0	1	0	1
Session 4	0	0	0	0	0	0	0
Total	0	0	0	0	1	0	1

V. Patient's Natural Communication Modality Use by Session

	Mouthing	Gesture (e.g., waving around the room, pointing, symbolic gestures, social gestures)	Head nod yes/no OR thumbs up/down yes/no	Facial Expression (e.g., smile, frown)	Non-verbal (but communicative) Action (e.g., purposeful looking, purposeful squeeze)	Audible (around trach) vocalization or speech	Totals
Session 1	1	0	2	0	2	0	5
Session 2	2	3	13	0	2	0	20
Session 3	4	2	14	0	1	0	21
Session 4	0	0	3	0	0	0	3
Total	7	5	32	0	5	0	49

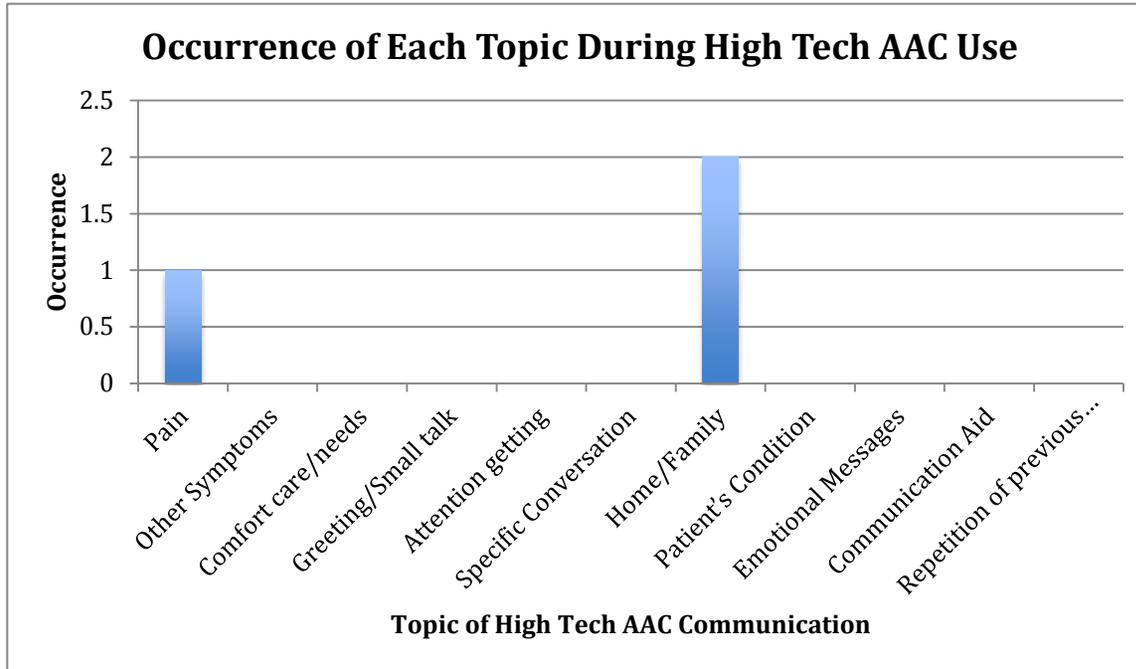
VI. Patient's Low Tech AAC Use by Session

(This patient did not use any low tech AAC)

VII. Patient High Tech AAC Communication Modality Use by Session

	Direct Selection - Spell	Direct Selection – Message (e.g. word, picture, phrase)	Scan – Word, Picture	Scan - Spell	Total
Session 1	0	0	0	0	0
Session 2	0	0	0	0	0
Session 3	3	0	0	0	3
Session 4	0	0	0	0	0
	3	0	0	0	3

### VIII. Topic of High Tech AAC Communication



IX. AAC Communication Acts (includes both low and high tech)

	# of patient communication acts	# of AAC acts	# of AAC acts in first 3 minutes (rate = n/3)	# of AAC acts after first 3 minutes (rate = n/x)
Session 1	5	0	0	0
Session 2	19	0	0	0
Session 3	21	3	3 (1)	0
Session 4	3	0	0	0
Totals	48	3	3 (0.25)	0

n = number of acts

x = length of remaining video (after 3 minutes)

**APPENDIX I**

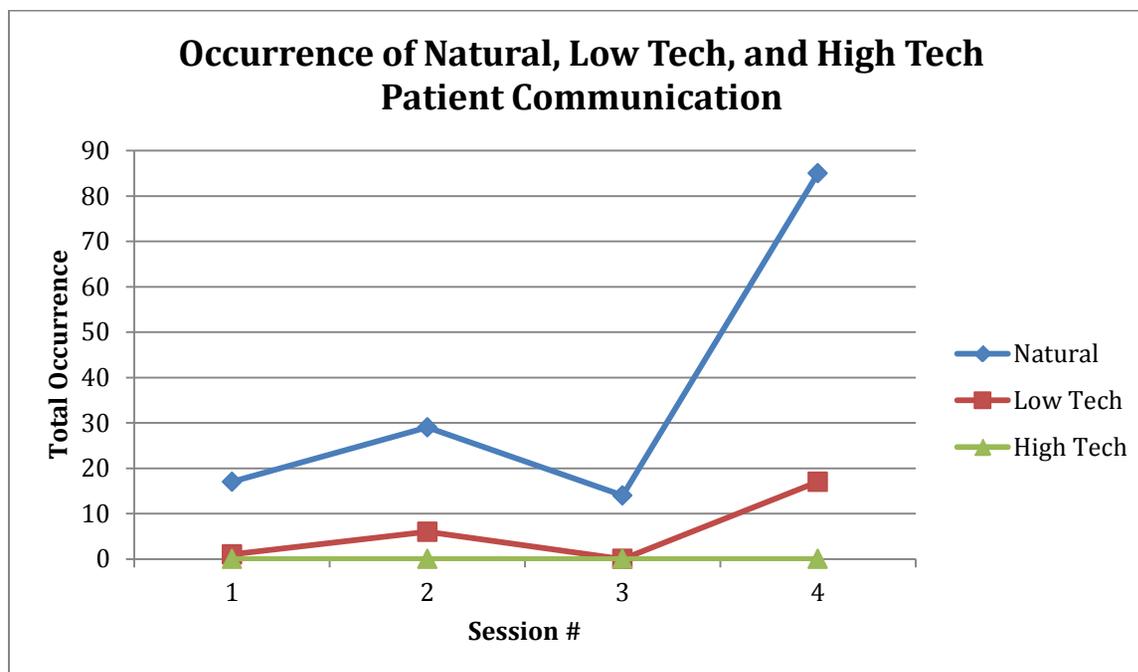
**PATIENT 7**

I. Topic Occurrence by Session

<b>Topic</b>	<b>Session 1</b>	<b>Session 2</b>	<b>Session 3</b>	<b>Session 4</b>	<b>Total</b>
Pain	2	0	0	5	7
Other Symptoms	0	2	0	1	3
Comfort care/needs	8	9	2	1	20
Greeting/Small talk	4	12	6	7	29
Attention getting	0	0	0	0	0
Specific Conversation	0	0	1	2	3
Home/Family	0	0	0	3	3
Patient's Condition	3	5	3	22	33
Emotional Messages	0	0	0	1	1
Communication Aid	1	0	0	8	9
Repetition of previous topic/utterance/communication act	0	0	0	19	19
Unable to interpret	1	0	1	6	8
<b>Total</b>	<b>19</b>	<b>28</b>	<b>13</b>	<b>75</b>	<b>135</b>

## II. Occurrence of Natural, Low Tech, and High Tech Patient Communication

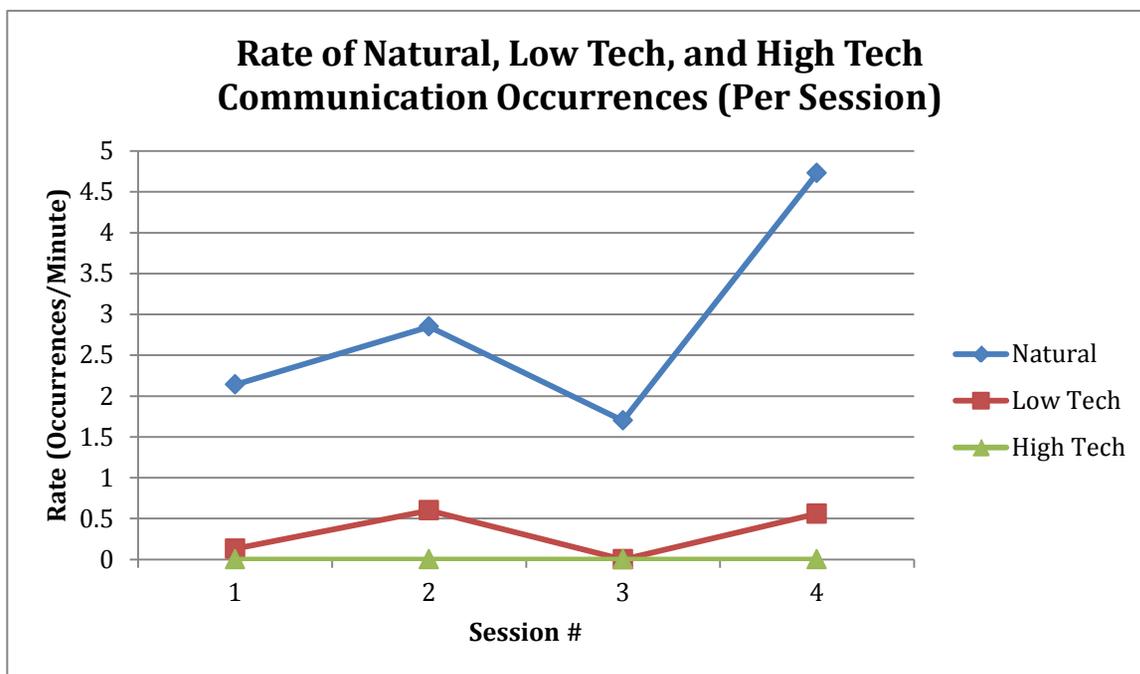
	Natural	Low Tech	High Tech	AAC Total	Total
Session 1	17	1	0	1	18
Session 2	29	6	0	6	35
Session 3	14	0	0	0	14
Session 4	85	10	0	10	95
Total	145	17	0	17	162



\* A patient can use more than 1 natural communication modality or multiple modalities within one communication act.

### III. Rate of Patient Communication (Occurrences Per Minute)

	Natural	Low Tech	High Tech	AAC Total
Session 1	2.14	0.13	0	0.13
Session 2	2.85	0.60	0	0.60
Session 3	1.70	0	0	0
Session 4	4.73	0.56	0	0.56
Mean rates	2.86	0.32	0	0.32



\* A patient can use more than 1 natural communication modality or multiple modalities within one communication act.

#### IV. Nurse Facilitative Behaviors

	Nurse Low Tech AAC Behaviors/Strategies				Nurse High Tech AAC Behaviors/Strategies			Total
	Uses partner dependent auditory scanning technique	Presents items needed (e.g., clipboard, pen, eye gaze board) for low tech communication	Provides written word choices (auditorially & graphically)	Instructs patient to refer to chart-based encoding strategy/interprets response	Positions device appropriately so that patient can physically access it	Reviews display/potential messages with patient when necessary	Physically assists patient to communicate	
Session 1	0	0	0	0	0	0	0	0
Session 2	0	0	0	0	1	0	0	1
Session 3	0	0	0	0	0	0	0	0
Session 4	0	8	0	0	1	0	2	11
Total	0	8	0	0	2	0	2	12

V. Patient's Natural Communication Modality Use by Session

	Mouthing	Gesture (e.g., waving around the room, pointing, symbolic gestures, social gestures)	Head nod yes/no OR thumbs up/down yes/no	Facial Expression (e.g., smile, frown)	Non-verbal (but communicative) Action (e.g., purposeful looking, purposeful squeeze)	Audible (around trach) vocalization or speech	Total
Session 1	0	7	3	0	7	0	17
Session 2	1	14	8	2	4	0	29
Session 3	0	10	1	0	3	0	14
Session 4	38	17	20	1	9	0	85
Total	39	48	32	3	23	0	145

VI. Patient's Low Tech AAC Use by Session

	Session 1	Session 2	Session 3	Session 4	Total
Drawing	0	0	0	0	0
Writing	1	6	0	10	0
Point to partner – generated written word choices	0	0	0	0	0
Point to partner – generated points on a graphic scale	0	0	0	0	0
First letter spelling while mouthing	0	0	0	0	0
Point to alphabet board	0	0	0	0	2
Point to locations on a drawn map	0	0	0	0	0
Point to an encoded symbol representing a phrase	0	0	0	0	0
Indicate letter in response to partner's auditory/visual scanning of alphabet	0	0	0	0	0
Indicate phrase in response to partner's auditory/visual scanning of phrase choice list	0	0	0	0	0

Talking trach valve	0	0	0	0	0
Eye gaze	0	0	0	0	0
Prepares message in advance for nurse caregiver	0		0	0	0
Total	1	6	0	10	17

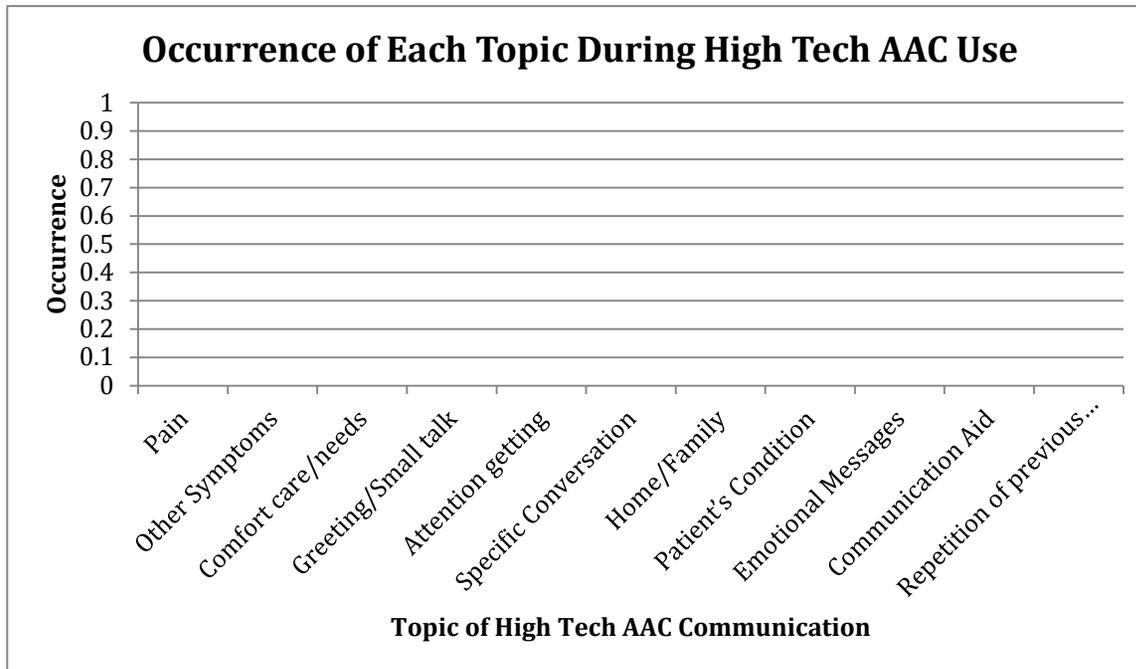
### VII. Patient High Tech AAC Communication Modality Use by Session

(Patient did not use high tech AAC)

	Direct Selection - Spell	Direct Selection – Message (e.g. word, picture, phrase)	Scan – Word, Picture	Scan - Spell	Total
Session 1	0	0	0	0	0
Session 2	10	0	0	0	0
Session 3	0	0	0	0	0
Session 4	0	0	0	0	0
Total	0	0	0	0	0

### VIII. Topic of High Tech AAC Communication

(Patient did not use high tech AAC)



IX. AAC Communication Acts (includes both low and high tech)

	# of patient communication acts	# of AAC acts	# of AAC acts in first 3 minutes (rate = n/3)	# of AAC acts after first 3 minutes (rate = n/x)
Session 1	20	1	1 (0.33)	0
Session 2	30	6	4 (1.33)	2
Session 3	13	0	0	0
Session 4	80	10	6 (2.00)	4
Totals	143	17	11 (0.92)	6 (0.19)

n = number of acts

x = length of remaining video (after 3 minutes)

**APPENDIX J**

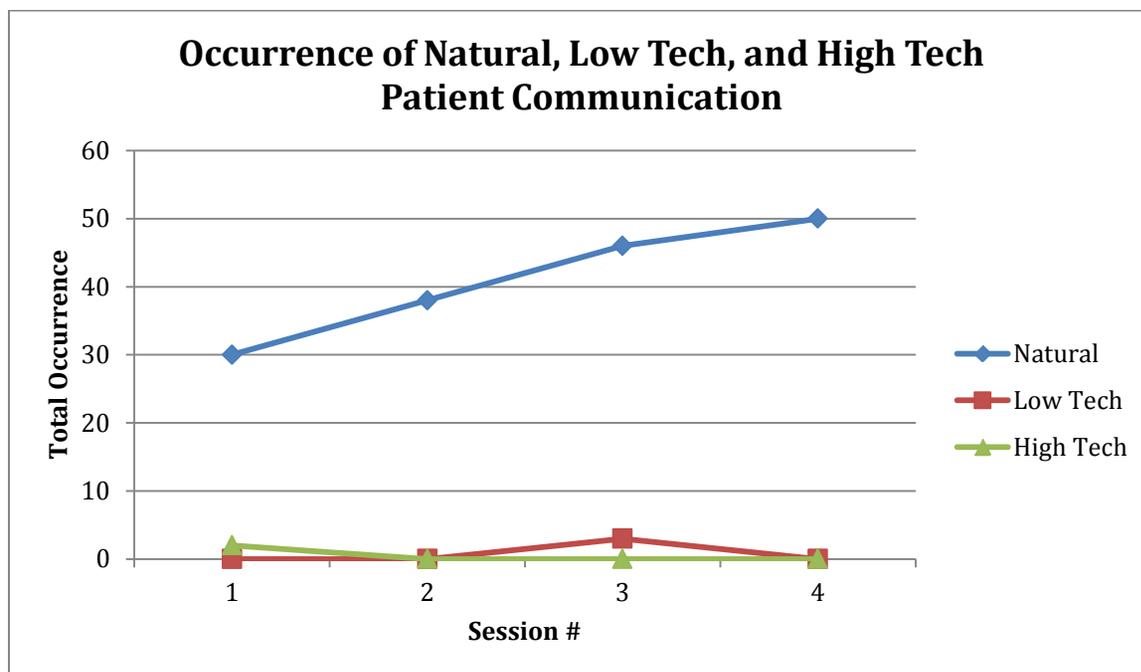
**PATIENT 8**

I. Topic Occurrence by Session

<b>Topic</b>	<b>Session 1</b>	<b>Session 2</b>	<b>Session 3</b>	<b>Session 4</b>	<b>Total</b>
Pain	1	2	3	1	7
Other Symptoms	0	6	1	0	7
Comfort care/needs	2	10	11	9	32
Greeting/Small talk	5	1	6	5	17
Attention getting	0	0	0	0	0
Specific Conversation	0	0	0	0	0
Home/Family	0	0	0	0	0
Patient's Condition	12	14	26	4	56
Emotional Messages	0	0	0	0	0
Communication Aid	1	0	0	0	1
Repetition of previous topic/utterance/communication act	1	0	0	1	2
Unable to interpret	0	0	0	0	0
<b>Total</b>	<b>22</b>	<b>33</b>	<b>47</b>	<b>20</b>	<b>122</b>

## II. Occurrence of Natural, Low Tech, and High Tech Patient Communication

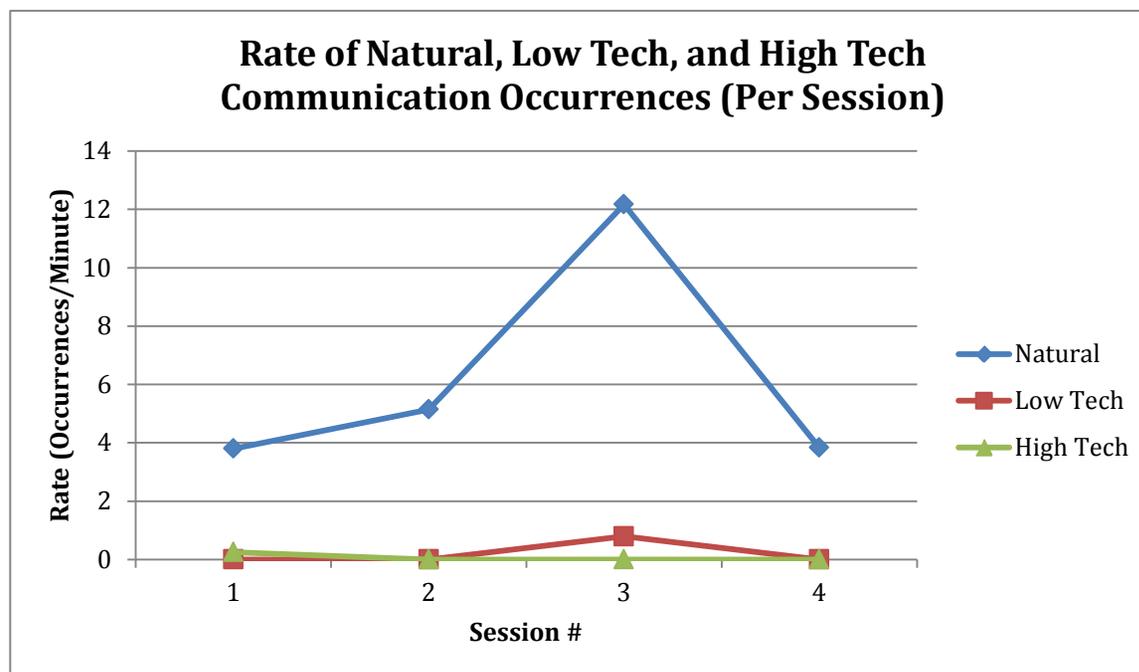
	Natural	Low Tech	High Tech	AAC Total	Total
Session 1	30	0	2	2	32
Session 2	38	0	0	0	38
Session 3	46	3	0	3	49
Session 4	30	0	0	0	30
Total	144	3	2	5	149



\* A patient can use more than 1 natural communication modality or multiple modalities within one communication act.

### III. Rate of Patient Communication (Occurrences Per Minute)

	Natural	Low Tech	High Tech	AAC Total
Session 1	3.80	0	0.25	0.25
Session 2	5.14	0	0	0
Session 3	12.17	0.79	0	0.79
Session 4	3.83	0	0	0
Mean rates	6.24	0.20	0.06	0.26



\* A patient can use more than 1 natural communication modality or multiple modalities within one communication act.

#### IV. Nurse Facilitative Behaviors

(No nurse facilitative behaviors present with this patient)

	Nurse Low Tech AAC Behaviors/Strategies				Nurse High Tech AAC Behaviors/Strategies			Total
	Uses partner dependent auditory scanning technique	Presents items needed (e.g., clipboard, pen, eye gaze board) for low tech communication	Provides written word choices (auditorially & graphically)	Instructs patient to refer to chart-based encoding strategy/interprets response	Positions device appropriately so that patient can physically access it	Reviews display/potential messages with patient when necessary	Physically assists patient to communicate	
Session 1	0	0	0	0	0	0	0	0
Session 2	0	0	0	0	0	0	0	0
Session 3	0	0	0	0	0	0	0	0
Session 4	0	0	0	0	0	0	0	0
Total	0	0	0	0	0	0	0	0

V. Patient's Natural Communication Modality Use by Session

	Mouthing	Gesture (e.g., waving around the room, pointing, symbolic gestures, social gestures)	Head nod yes/no OR thumbs up/down yes/no	Facial Expression (e.g., smile, frown)	Non-verbal (but communicative) Action (e.g., purposeful looking, purposeful squeeze)	Audible (around trach) vocalization or speech	Total
Session 1	7	5	14	2	2	0	30
Session 2	5	0	32	0	1	0	38
Session 3	9	2	28	2	5	0	46
Session 4	5	4	11	4	6	0	30
Total	26	11	85	8	14	0	144

VI. Patient's Low Tech AAC Use by Session

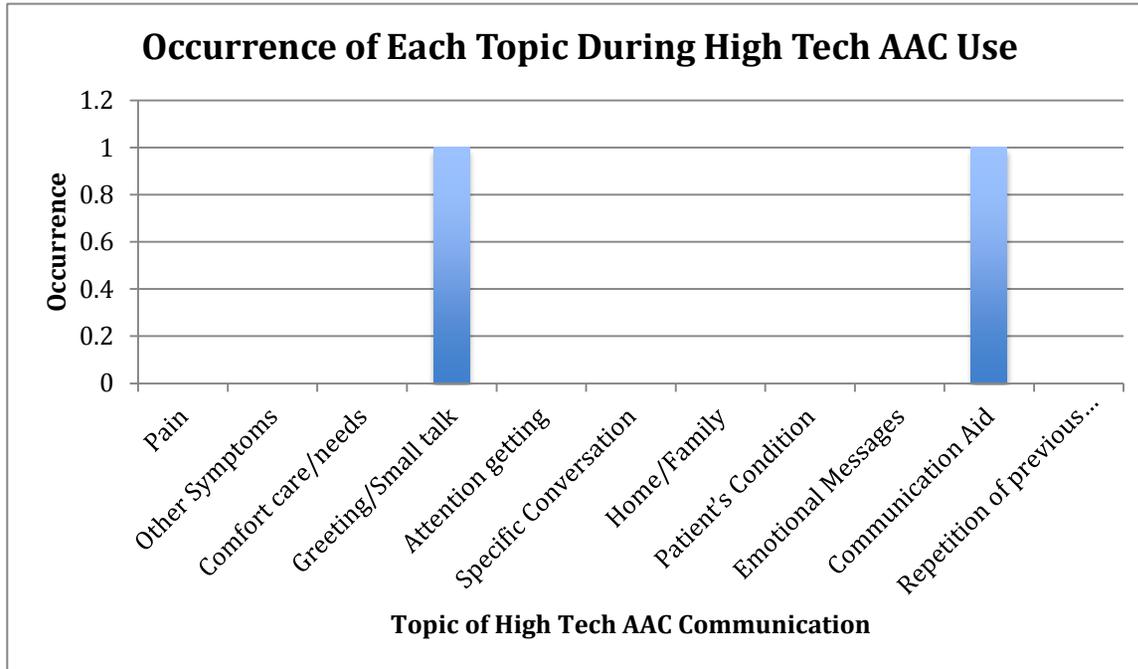
	Session 1	Session 2	Session 3	Session 4	Total
Drawing	0	0	0	0	0
Writing	0	0	0	0	0
Point to partner – generated written word choices	0	0	0	0	0
Point to partner – generated points on a graphic scale	0	0	0	0	0
First letter spelling while mouthing	0	0	0	0	0
Point to alphabet board	0	0	3	0	3
Point to locations on a drawn map	0	0	0	0	0
Point to an encoded symbol representing a phrase	0	0	0	0	0
Indicate letter in response to partner's auditory/visual scanning of alphabet	0	0	0	0	0
Indicate phrase in response to partner's auditory/visual scanning of phrase choice list	0	0	0	0	0

Talking trach valve	0	0	0	0	0
Eye gaze	0	0	0	0	0
Prepares message in advance for nurse caregiver	0		0	0	0
Total	0	0	3	0	

VII. Patient High Tech AAC Communication Modality Use by Session

	Direct Selection - Spell	Direct Selection – Message (e.g. word, picture, phrase)	Scan – Word, Picture	Scan - Spell	Total
Session 1	2	0	0	0	2
Session 2	0	0	0	0	0
Session 3	0	0	0	0	0
Session 4	0	0	0	0	0
Total	2	0	0	0	2

### VIII. Topic of High Tech AAC Communication



IX. AAC Communication Acts (includes both low and high tech)

	# of patient communication acts	# of AAC acts	# of AAC acts in first 3 minutes (rate = n/3)	# of AAC acts after first 3 minutes (rate = n/x)
Session 1	22	2	0	2 (0.41)
Session 2	33	0	0	0
Session 3	47	3	3 (1)	0
Session 4	20	0	0	0
Totals	122	5	3 (0.25)	2 (0.13)

n = number of acts

x = length of remaining video (after 3 minutes)

**APPENDIX K**

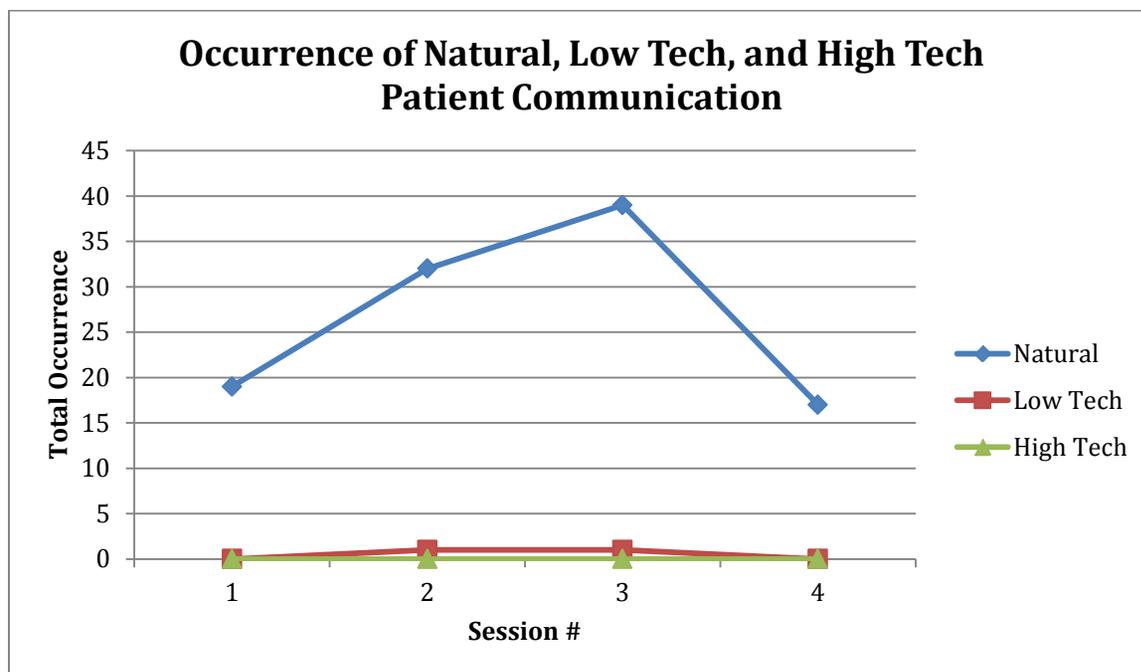
**PATIENT 9**

I. Topic Occurrence by Session

<b>Topic</b>	<b>Session 1</b>	<b>Session 2</b>	<b>Session 3</b>	<b>Session 4</b>	<b>Total</b>
Pain	1	4	12	2	19
Other Symptoms	0	0	0	1	1
Comfort care/needs	0	6	0	8	14
Greeting/Small talk	0	2	4	4	10
Attention getting	0	0	0	0	0
Specific Conversation	0	0	0	0	0
Home/Family	0	0	0	1	1
Patient's Condition	12	12	12	2	38
Emotional Messages	0	0	0	0	0
Communication Aid	0	2	0	0	2
Repetition of previous topic/utterance/communication act	0	0	0	0	0
Unable to interpret	0	0	0	0	0
<b>Total</b>	<b>13</b>	<b>26</b>	<b>28</b>	<b>18</b>	<b>85</b>

## II. Occurrence of Natural, Low Tech, and High Tech Patient Communication

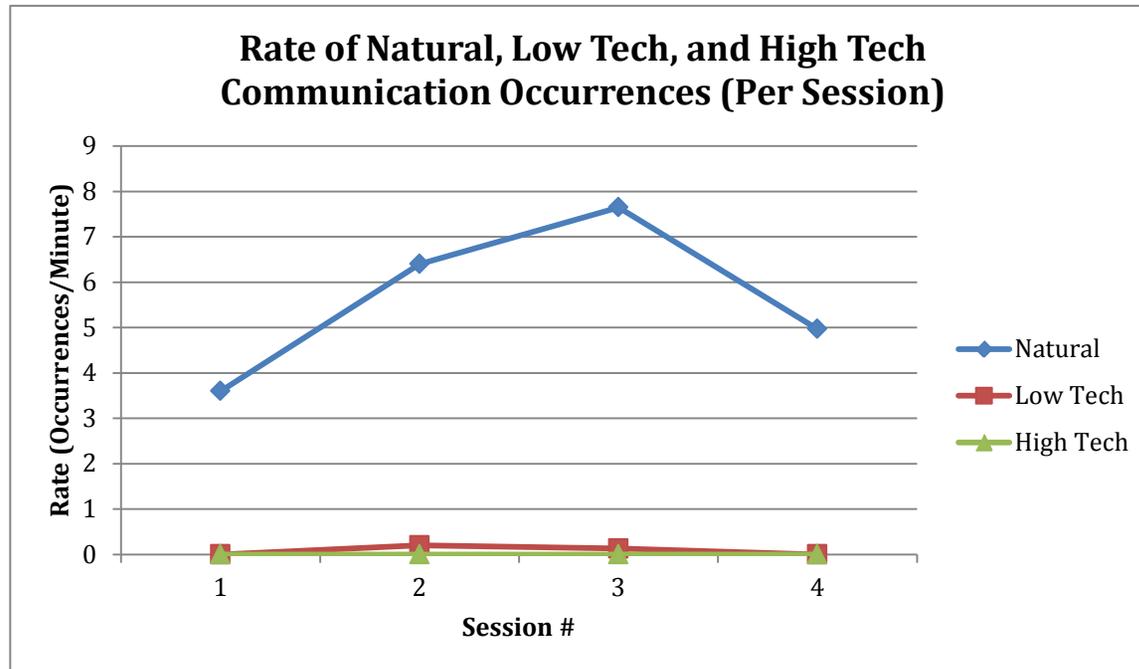
	Natural	Low Tech	High Tech	AAC Total	Total
Session 1	19	0	0	0	19
Session 2	32	1	0	1	33
Session 3	39	1	0	1	40
Session 4	17	0	0	0	17
Total	107	2	0	2	109



\* A patient can use more than 1 natural communication modality or multiple modalities within one communication act.

### III. Rate of Patient Communication (Occurrences Per Minute)

	Natural	Low Tech	High Tech	AAC Total
Session 1	3.60	0	0	0
Session 2	6.40	0.20	0	0.20
Session 3	7.65	0.13	0	0.13
Session 4	4.97	0	0	0
Mean rates	5.66	0.08	0	0.08



\* A patient can use more than 1 natural communication modality or multiple modalities within one communication act.

#### IV. Nurse Facilitative Behaviors

	Nurse Low Tech AAC Behaviors/Strategies				Nurse High Tech AAC Behaviors/Strategies			Total
	Uses partner dependent auditory scanning technique	Presents items needed (e.g., clipboard, pen, eye gaze board) for low tech communication	Provides written word choices (auditorially & graphically)	Instructs patient to refer to chart-based encoding strategy/interprets response	Positions device appropriately so that patient can physically access it	Reviews display/potential messages with patient when necessary	Physically assists patient to communicate	
Session 1	0	0	0	0	0	0	0	0
Session 2	0	1	0	0	0	0	0	1
Session 3	0	1	0	0	0	0	0	1
Session 4	0	0	0	0	0	0	0	0
Total	0	2	0	0	0	0	0	0

V. Patient's Natural Communication Modality Use by Session

	Mouthing	Gesture (e.g., waving around the room, pointing, symbolic gestures, social gestures)	Head nod yes/no OR thumbs up/down yes/no	Facial Expression (e.g., smile, frown)	Non-verbal (but communicative) Action (e.g., purposeful looking, purposeful squeeze)	Audible (around trach) vocalization or speech	Total
Session 1	1	2	10	1	5	0	19
Session 2	8	4	11	6	3	0	32
Session 3	15	4	12	3	5	0	39
Session 4	0	1	13	1	2	0	17
Total	24	11	46	11	15	0	107

VI. Patient's Low Tech AAC Use by Session

	Session 1	Session 2	Session 3	Session 4	Total
Drawing	0	0	0	0	0
Writing	0	2	1	0	3
Point to partner – generated written word choices	0	0	0	0	0
Point to partner – generated points on a graphic scale	0	0	0	0	0
First letter spelling while mouthing	0	0	0	0	0
Point to alphabet board	0	0	0	0	0
Point to locations on a drawn map	0	0	0	0	0
Point to an encoded symbol representing a phrase	0	0	0	0	0
Indicate letter in response to partner's auditory/visual scanning of alphabet	0	0	0	0	0
Indicate phrase in response to partner's auditory/visual scanning of phrase choice list	0	0	0	0	0

Talking trach valve	0	0	0	0	0
Eye gaze	0	0	0	0	0
Prepares message in advance for nurse caregiver	0		0	0	0
Total	0	2	1	0	3

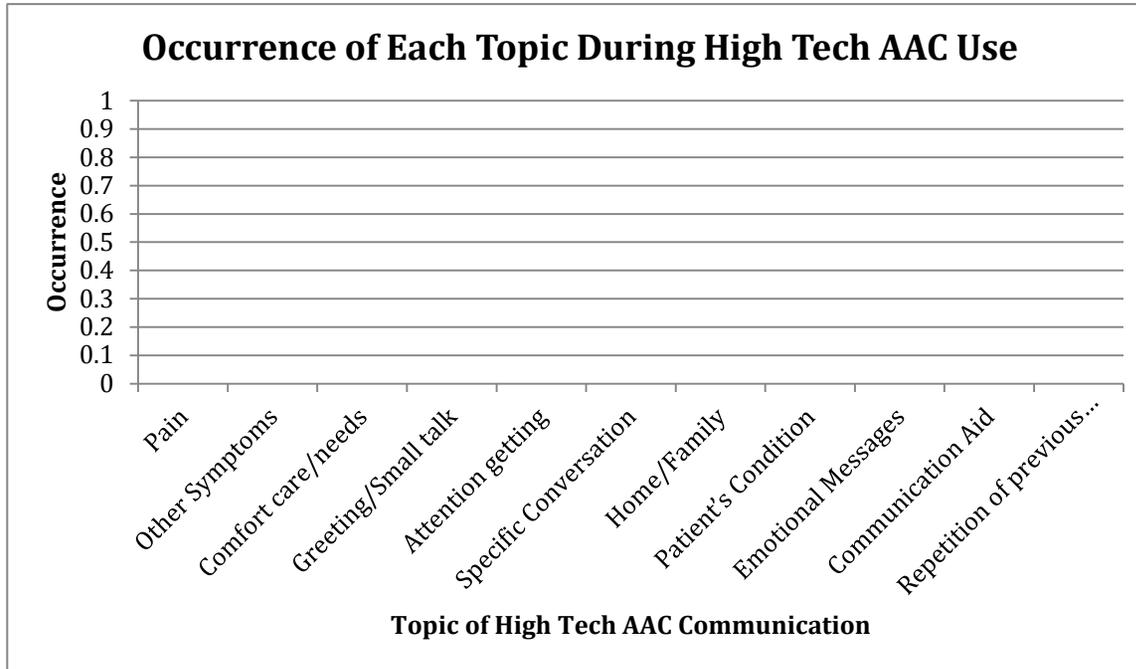
### VII. Patient High Tech AAC Communication Modality Use by Session

(No high tech AAC use in this session)

	Direct Selection - Spell	Direct Selection – Message (e.g. word, picture, phrase)	Scan – Word, Picture	Scan - Spell	Total
Session 1	0	0	0	0	0
Session 2	0	0	0	0	0
Session 3	0	0	0	0	0
Session 4	0	0	0	0	0
Total	0	0	0	0	0

### VIII. Topic of High Tech AAC Communication

(No high tech AAC Use in this session)



IX. AAC Communication Acts (includes both low and high tech)

	# of patient communication acts	# of AAC acts	# of AAC acts in first 3 minutes (rate = n/3)	# of AAC acts after first 3 minutes (rate = n/x)
Session 1	13	0	0	0
Session 2	26	1	0	1 (0.50)
Session 3	28	1	0	1 (0.48)
Session 4	18	0	0	0
Totals	85	2	0	2 (0.29)

n = number of acts

x = length of remaining video (after 3 minutes)

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