Computer-Generated Reports of Speech and Language Evaluations

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A system for computer generation of speech and language evaluation reports is described. A computer-compatible form is used to codify many of the routine clinical observations made by speech and language pathologists working in craniofacial centers. Information recorded on that form is incorporated into a computer-generated report. The system provides a rapid, accurate and simple means of gathering clinical data and reporting it in prose format.

Speech and language pathologists spend a good deal of their professional time generating written documentation of their evaluations and treatment services. However, our primary purpose as professionals is to provide patient care. In that context, report-writing is a necessary evil. Not only does it reduce the time available for patient contact, but it also consumes an inordinate amount of secretarial effort. Clearly, report-writing is not a cost-effective clinical activity.

Speech and language evaluation reports not only are inefficient to produce but often are fraught with errors of omission. These omissions may be due to a lack of information obtained during the evaluation or the result of oversight by the examiner when documenting the evaluation findings. The probability of this happening might be expected to increase in clinic settings where insufficient time is allotted for report writing.

In an attempt to address the problems mentioned above, a computer-compatible clinical evaluation form was created for use in the Oral-Facial and Communicative Disorders Program (OFCDP) at the University of North Carolina-Chapel Hill. Data recorded on this form are stored in each patient's computer file using programs developed by Strauss and Boyd (1977). This information is incorporated into a speech and language report for each patient, using a computer program specifically developed for that purpose by the author and Ms. Gloria Faley. This article presents the clinical evaluation form and illustrates the flexibility inherent in the program written to generate the speech and language evaluation reports.

Clinical evaluation form

The two-page form used for collecting data during a clinical evaluation is presented in Appendix 1. Pertinent background information is provided in the upper left-hand corner. A diagnosis of the patient's oral-facial problem can be entered longhand or can be noted by an appropriate number.

The notation "Best History Report" refers to the date of the speech and language evaluation report that includes the most complete background history. It was not practical to write a report capable of handling all possible patient history information. Therefore, the initial diagnostic report on a patient must be written in a conventional manner. The computer-generated evaluation reports described here

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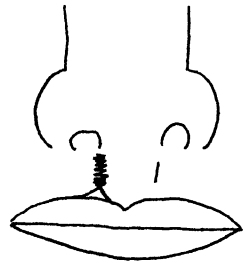
APPENDIX 1. *SPEECH AND LANGUAGE EVALUATION FORM*

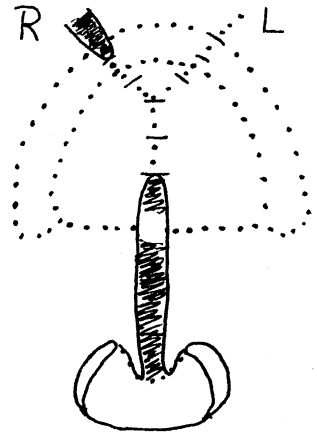
Patient Mock Patient ID# 99-99-01
Preferred First Name Mock Diagnosis 13
DOB 2/14/72 Age ____ Phone(9/9) 762-4301
Address 101 Ridge Road
Rocky Mound, N.C. 28320
Woman of the house Ima Patient
Man of the house —

Repair Dates: Lip 4/72 Palate 8/73
First Visit '72 Best History Report 10/22/79
Last Visit 2/20/80 :Clinician R. Sabala
Findings: V-P 1 Hyper. 2 Hypo. 2 NE 1
Artic. 4 Rec. 3 Expr. 4

Informant Ima Patient
Tx: 0 ___, Never ___, Current ✓, Terminated ___
By Ms. Jane Clemens
At Rocky Mound/Elem.
Tx Sessions/Week 2 Indiv. ✓ Group ___ Both ___

Today's Date 2/22/82
Eval. type 2 (/Full;2/Modified)
Visit# 6





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	N/A	Normal					Severe	
Lip Mobility	0	1	2	3	(4)	5	6	Lip unoperated ___
Tongue: protrusion	0	1	2	3	4	5	6	
tip elevation	0	1	2	3	4	5	6	
lateralization								
L	0	1	2	3	4	5	6	
R	0	1	2	3	4	5	6	
pointing	0	1	2	3	4	5	6	

Angle Class Occlusion 0 I ___ I mal ✓ II ___ II Div 1 ___ II Div 2 ___ III ___ Pseudo III ___
Crossbite 0 Anterior ___ ✓ Left Post ___ Right Post ___ Bilat Post ___ None ___
Openbite 0 Anterior ___ Left Post ___ Right Post ___ Bilat Post ___ None ✓

Palatal (e) Inc. foramen — mm. Hard/soft palate 5 mm. Other —
Velar Morphology Unop ___ Intact ___ Wide flap ___ Narrow flap ___ Flap Width? ✓ B.U. ___
Velar/Palatal Tag Length 0 1 2 3 4 5 6

V-P Activity (phonation)
Velum 0 1 (3) 5 6
Velar elevation Symmetrical ✓ Deviated to left ___ Deviated to right ___

LPW - left	0	(1)	3	5	6	Tonsil blocks view___
LPW - right	0	(1)	3	5	6	Tonsil blocks view___
M. Uvulae	0	present___	absent ✓			
V-P Activity (gag)						
Velum	0	(1)	3	5	6	No gag___
LPW - left	0	(1)	3	5	6	Tonsil blocks view___
LPW - right	0	(1)	3	5	6	Tonsil blocks view___
M. Uvulae	0	present___	absent ✓			
Levator Insertion	0	Ant. 1/3___	Middle 1/3___	Post. 1/3 ✓	Not visible___	
Tonsil Size	0	+1 +2	(+3) +4	5		
SPEECH PRODUCTION CHARACTERISTICS						
Hypernasality	0	1	(2) 3	4 5	6	7
Hyponasality	0	1 2	(3) 4	5	6	
Nasal Obstruction	0	left___	right___	both(no URI)___	both(URI) ✓	none___
Nasal Emission	0	1 2	(3) 4	5	6	7
Tongue Anchor	0	Passed___	Failed ✓	Could not test___		
Facial Grimace	0	(1)	2 3	4 5	6	
Vocal Intensity	0	(1)	2 3	4 5	6	
V-P Function for Speech	0	Adequate___	Marginal ✓	Inadequate___		
Pressure-Flow		0 Agreed with examiner ✓	Disagreed with examiner___			
		Testing invalid (nasal obstruction)___				
		Closure___	<5mm___	<10mm___	<20mm ✓	<70mm___ <70mm___
Articulation Testing	0	Informal___	Fisher-Logemann ✓	Arizona___	G-F___	
Articulation Report	0	Addit. Inf.___	F-L matrix ✓	Arizona matrix___		
Articulation Problem	0	1 2	3	(4) 5	6	
Articulation in Conversation		Same as Artic. test___	Worse ✓	Better___		
Intelligibility	0	1 2	3 4	5	(6)	
"V-P" Articulation Errors	0	None___ ʔ ✓	ʂ ✓	ʃ___	ɻ ✓	∆___
Speech Related to Occlusion	0	no ✓	yes___	could not determine___		

FOLLOWING CHARACTERISTICS PRESENT:

1-myofunct 2-dev artic 3-apraxia 4-dysarth 5-pros appl 6-MH

APPENDIX 1. SPEECH AND LANGUAGE EVALUATION FORM—continued

Language Evaluation 0 Informal___ Informal(time)____ Informal(cooper.)____
Formal(no extended report)___ Formal(report) ✓

Receptive	0	1	(2)	3	4	5	6	Normal for M.A.___
Expressive	0	1	2	3	(4)	5	6	Normal for M.A.___

Audio: (R) 0 None ✓ Cond.___ S-N___ Mixed___ Non-organic___

(L) 0 None___ Cond. ✓ S-N___ Mixed___ Non-organic___

Pure-tone, air, 3-frequency average loss:

(R)	0	(1)	2	3	4	5	6
(L)	0	1	(2)	3	4	5	6

Voice Quality	0	(OK)	Br	Ho	Ha	P.Br.	G.Fry	Pi
Dysfluencies	0	1	(2)	3	4	5	6	Normal for age___

OTHER INFORMATION

Speech Recording? yes ✓ no___
Tape # 202

RESIDENT SESSION: 1-Winter 2-Spring 3-Summer (4)-Fall of '82
contingent upon ——

OTHER FINDINGS:_____

CLINICIAN: Rodger K. Dalston

are used to document information on returning patients only.

The "Last Visit" entry identifies the date of the patient's last team evaluation. Selected findings from that evaluation are recorded in the computerized report (see Appendix 1, Paragraph 2).

The "Tx" entries enable the clinician to record whether the patient ever had speech therapy. If the patient had speech or language treatment in the past, but no longer receives such services, it is possible to note the date at which that treatment was terminated and by whom. The source and frequency of any current therapy also can be recorded in this upper left-hand section.

To the right of the evaluation form is a set of two pictures which enables the clinican to generate a quick pictorial representation of any structural abnormality involving the perioral and/or palatal area. One of those drawings separates the velum, hard palate and primary palate into thirds. This allows for simple documentation of the amount of clefting in any of these areas. This information is not entered into the computer but does serve as a useful reminder to the clinican when meeting with the entire team to discuss patients.

For purposes of illustration, lines have been drawn on the diagrams in Appendix 1 to represent a situation in which there is a right unilateral cleft of the lip with notching of the alveolar ridge and a cleft of the secondary palate extending approximately one-third of the distance from the end of the palatine bone to the incisive foramen. Additional lines have been drawn to reflect the fact that this hypothetical patient has undergone surgical repair of the lip and palate but presents with a fistula at the junction of the hard palate and velum.

Although a fistula may occur at any point within the oral cavity, the evaluation form presented reflects the fact that they occur most often in the area of the incisive foramen and at the junction of the hard palate and velum. Fistulae occurring at one or both of these points are noted by inserting a number reflecting the maximum inside diameter, in millimeters. Oral-nasal fistulae frequently are found in the labial sulcus of patients with clefts involving the primary palate. However, they rarely affect speech and, as such, are not included among the possible options on the evaluation form. If clinically significant, fistulae not accounted for on the form may be noted by the clinician in the Additional Information section of the report.

The "Velar Morphology" options are such that a patient with an unoperated cleft involving the velum is identified by checking the option labeled "Unop". A patient on whom primary palatoplasty has been performed, or an individual whose velum never was cleft, is denoted by marking the "Intact" option. If a posterior pharyngeal flap is known to exist but is not visible upon intra-oral inspection, the option "Flap width?" is checked. When a patient presents with a flap, no judgment of "Velar/Palatal Tag Length" is made.

At the end of the speech and language evaluation form, under a section entitled "Other Information", it is possible to note whether the patient's speech has been recorded using a formal protocol. If a speech sample has been obtained, it is possible to note the tape location of that recording. This information is not utilized in generating the speech and language report, but it does facilitate the retrieval of speech samples for clinical and research purposes.

Computer-generated report

A sample report is presented in Appendix 2 to provide the reader with some appreciation of the flexibility built into the program used to generate the speech and language evaluation reports. The data used to generate these reports are recorded in Appendix 1.

The last entry in the computerized speech and language report is a section entitled "Additional Information". Any required elaboration of information presented in the preceding sections can be typed onto the hard copy of the computer printout. In addition, idiosyncratic information that is not amenable to computer documentation is typed into this section of the report.

A final section of the speech and language report, entitled "Recommendations", is added by the clinician. Some state-

APPENDIX 2.

PATIENT Mock Patient NCMH NUMBER 99 -99 -01
BIRTHDATE 02 /14 /72
EVALUATION DATE 02 /22 /82 AGE 10 -00
PARENTS Ms. Ima Patient PHONE (919) 762 -4301
ADDRESS 101 Ridge Road Rocky Mount NC 28320

REASON FOR EVALUATION Modified Team Diagnostic

BACKGROUND

Mock was born with an incomplete cleft involving both the primary and secondary palates.

Primary lip repair was performed in APRIL 1972 and primary palatoplasty was performed in AUGUST 1973. This patient has been followed by the Oral-Facial and Communicative Disorders Program since 1972. A more complete history can be found in the OCTOBER 22, 1977 Report of Speech and Language Evaluation on this individual.

Mock was last seen for speech evaluation on FEBRUARY 20, 1980. At that time the velopharyngeal mechanism was judged to be adequate for speech. There was mild hypernasality, no nasal emission, and mild hyponasality evident during conversational speech. A moderate articulation problem was noted ,the nature of which was described in the FEBRUARY 20, 1980 Report of the Speech and Language Evaluation by R. Sakata. Receptive language was judged to be mild-to-moderately impaired and expressive language skills were judged to be moderately impaired.

According to Ms Ima Patient, who served as informant during the evaluation today, Mock currently is being seen for therapy by Ms. Jane Clement at Rocky Mount Elem. 2 times a week for individual therapy.

FINDINGS

Lip mobility was moderately impaired. Examination of lingual movements during voluntary, non-speech tasks revealed normal tongue function. Mock presented with an Angle Class I malocclusion with an anterior cross-bite.

Intra-oral examination revealed a 05 millimeter wide fistula at the junction of the hard and soft palate. A posterior pharyngeal flap was in place. Therefore, no attempt was made to estimate the absolute length of the velum. Velar elevation during phonation was moderate and symmetrical. Phonation also was accompanied by extensive lateral pharyngeal wall (LPW) activity and no activity of the musculus uvulae. There was extensive velar, extensive LPW, and no musculus uvulae activity observed during a gag. The effective point of levator palatini insertion was found to be in the posterior third of the velum. The tonsils were quite large, causing distention of the faucial pillars.

Mock's speech was characterized by mild hypernasality and mild-to-moderate hyponasality. This latter resonance distortion may have been related to bilateral nasal obstruction that appeared to be due to a cold. Based upon mirror fogging, See-Scape evaluation and/or perceptual judgments by the examiner, mild-to-moderate nasal emission was evident in the patient's speech. There was no facial grimacing observed during the

evaluation today. Overall vocal intensity was within normal limits. In summary, the patient's velopharyngeal mechanism was judged to be marginally adequate for speech. This subjective impression was substantiated by pressure-flow testing conducted during the examination today. This testing revealed velopharyngeal apertures that were 10 to 20 square millimeters during repeated productions of the word "papa."

Mock's articulation skills were assessed utilizing the Fisher-Logemann Test of Articulation Competence. The patient was found to have a moderate articulation problem. A record of the articulation errors is to be found below

	PREVOCALIC	INTERVOCALIC	POSTVOCALIC
PLOSIVES	ʔ/p, ʔ/k	ʔ/k	-/k, -/p, -/b
FRICATIVES	f̃/f, f/s, f/z, f̃/θ	f/s, f/z, f/ʃ f/ʒ, f̃/θ	f/s, -/z, f/ʃ, f/ʒ, -/θ
AFFRICATES	pf/ʧ, pf/ʤ	pf/ʧ, pf/ʤ	-/ʧ, f/ʤ
SEMIVOWELS	ɯ/r, j/l	ɯ/r	ɜ/ɹ
NASALS			
BLENDS	f/s in all blends, Br/fr, ẗr/tr, mb̈l/bl		

Articulation tended to deteriorate during conversational speech. Overall intelligibility was judged to be severely impaired.

Formal assessment suggested that receptive language was mildly impaired and and expressive language skills were moderately impaired. Further information concerning the patient's language skills may be found in the ADDITIONAL INFORMATION section of this report.

Audiometric testing conducted during the team evaluation today revealed normal hearing in the right ear, and a mild conductive hearing loss in the left ear. Mock 's voice quality was within normal limits. Thus, there was no clinical indication of laryngeal pathology. There were mild dysfluencies observed in the patient's speech which are described in further detail below.

ADDITIONAL INFORMATION

ment regarding prognosis is included in this section.

While not specifically generated with this intent, the system described here ensures that the evaluation reports meet the Professional Standards and Review Organization (PSRO) requirements currently under consideration in several states. Moreover, the system is sufficiently flexible that additional items, such as pharyngoscopic and/or cephalometric observations, can be added quite easily.

Virtually all the data recorded on the clinical evaluation form are used in writing the speech and language report. Therefore, a final error check occurs when the clinician proof-reads the report.

Discussion

Considering the widespread availability of various stand-alone word processors, it would be highly desirable to employ such a device to perform the functions described in this paper. However, this is beyond the capability of virtually all word processors currently available. Conditional branching is used repeatedly to generate sentences in the speech and language reports presented here. Production of a comparable document utilizing a word processor would necessitate storage of an inordinate number of alternative sentences or phrases whose recall and invidualization would be unacceptably tedious and error-prone. Two examples may help illustrate this point.

Figure 1 presents the logical steps necessary to write one of the sentences in the speech and language report. Creation of this sentence using a word processor would require storage of four separate phrases or three different sentences. In the former case, concatenation of the appropriate set of phrases would be left to the operator. After retrieval of the required phrase string or sentence, the operator of most currently available stand-alone word processors would be obliged to type in the parenthesized information found in Figure 1 to make the sentence uniquely applicable to a specific patient.

Figure 2 depicts a more complicated sentence construction representative of several sentences in the speech and language evaluation report. A report containing such complex sentences cannot be generated by stand-alone word processors with the degree of flexibility, accuracy and minimal man-machine interaction that is characteristic of the system described here.

In addition, use of a word processor does not allow for data storage and subsequent statistical analysis. At the present time, data generated by the speech and language pathology staff is merged with information about a patient provided by other professionals represented on the OFCDP team. The system used to handle these data was generated by Strauss and Boyd (1977) and runs on an IBM 370/155 mainframe computer. This system ensures long-term data storage which facilitates both retrospective and prospective research at our institution.

The system developed by Stauss and Boyd has been used for the past six years to generate reports summarizing our entire team's findings and recommendations on each patient. However, the utility of this team summary report frequently is compromised because not all team members routinely submit information concerning their clinical findings. This lack of total cooperation appears to be due to the fact that the clinicians involved receive no immediate benefit from providing these data. In part, it was this presumption that led to development of the system described here. As a direct result of this project, information provided by the speech and language staff not only adds to the research data base but also reduces the time each clinician must spend dictating diagnostic reports.

Batch processing currently is used for data input from all specialties other than speech and language pathology. For this reason, the team summary report usually is not available for approximately one week. In an attempt to reduce turn-around time, and as a first step toward increasing the general applicability of the system described here, speech and language data input is performed on-line utilizing an Apple II Plus microprocessor functioning as an intelligent terminal. It takes approximately 10 minutes to input data on a single patient. This includes the time it takes the operator to perform two complete checks of the speech and language data set.

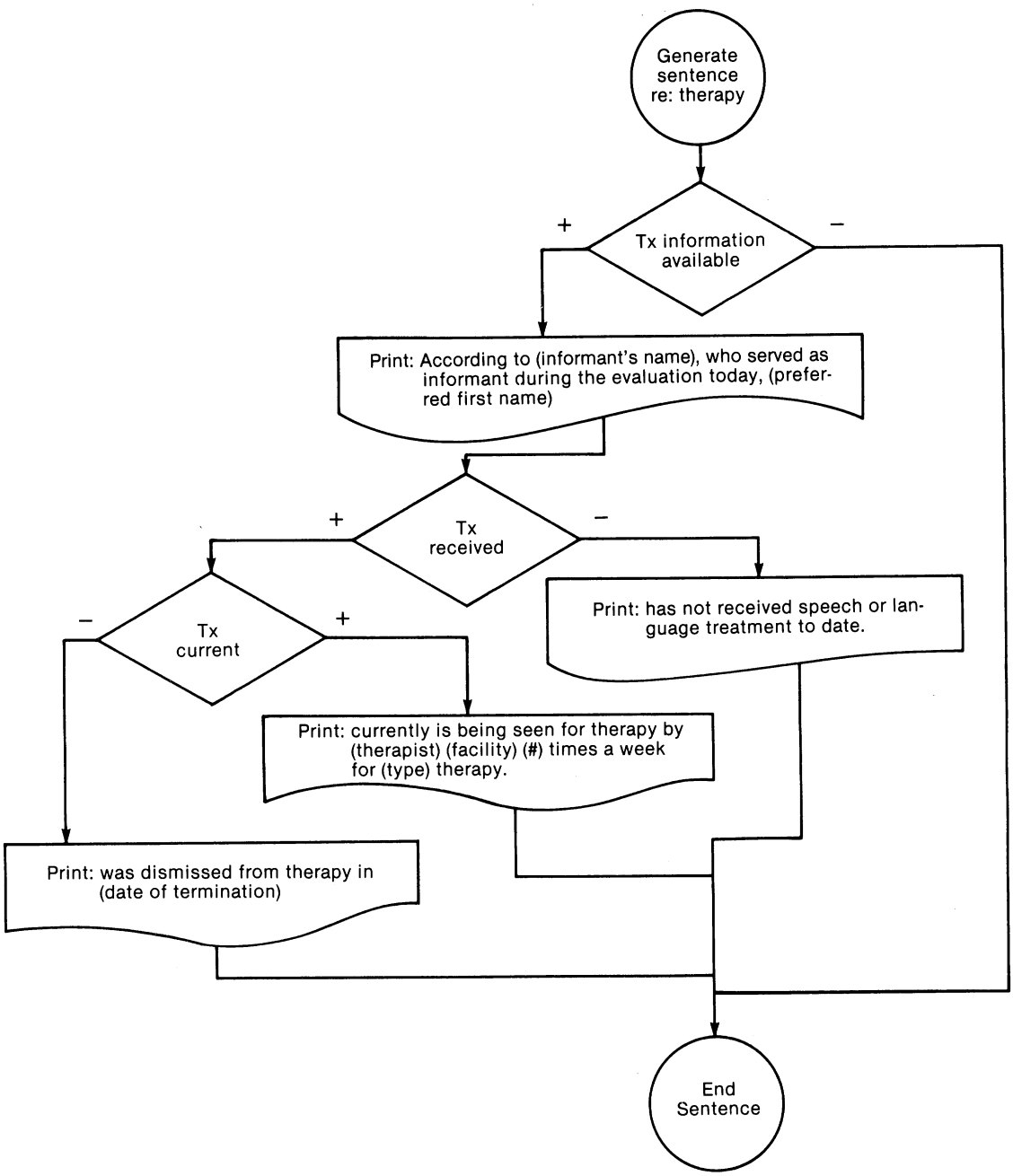

FIGURE 1. Flow Chart depicting conditional transfers employed in creating one sentence. See page 1, paragraph 3 in Appendix 2 for example of end product.

Significant time-sharing constraints are imposed upon the Strauss and Boyd system when run at the university's academic computer installation. Therefore, speech and language reports generated on patients seen one day still are not available to the clinician until the next day.

A concerted effort is being made to reduce turn-around time further by effecting data storage and report generation on an

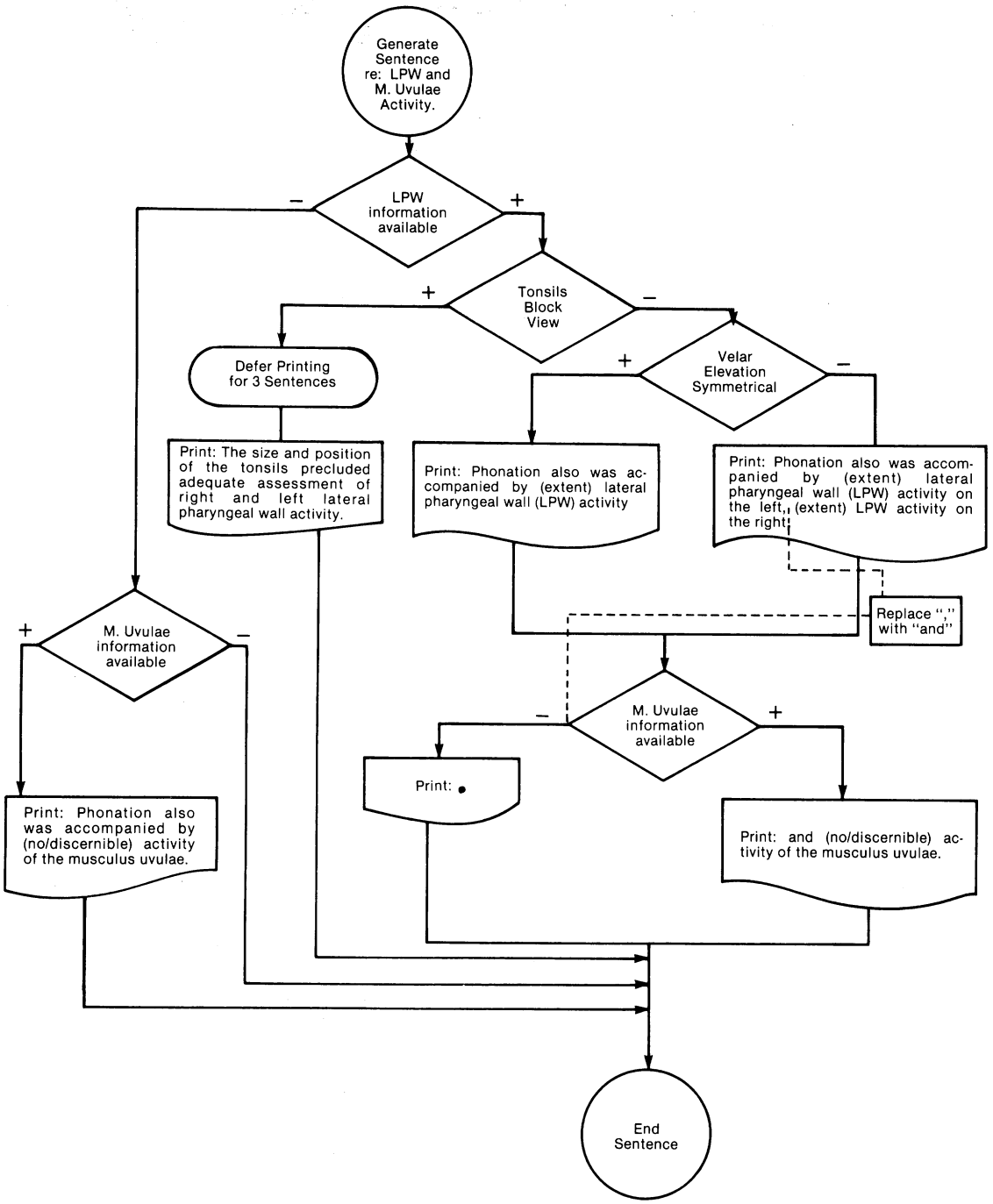

FIGURE 2. Flow chart depicting creation of sentence describing lateral pharyngeal wall and musculus uvulae activity. See page 1, paragraph 5 in Appendix 2 for example of end product.

Apple II Plus microprocessor with a printer and one disk drive. It is anticipated that turn-around time for this stand-alone system will be approximately 15 minutes. When fully operational in the near future, this system for storing and processing speech and language evaluation data should be extremely useful to any clinic or

individual clinician with access to a microprocessor and printer.

Conclusion

The system described in this paper has been in use for approximately five months. Our experience to date is that it is an extremely beneficial addition to our clinic operation. It has alleviated much of the tedium associated with writing reports and freed our speech and language pathology staff to spend more time in direct patient contact.

References

STRAUSS, RONALD P and BOYD, DONALD. A computer system to enhance cleft palate team communication: data collection and the generation of patient and hospital files. Paper presented at the Third International Congress on Cleft Lip and Related Craniofacial Anomalies, Toronto, June, 1977.