

Programmed instruction was developed to be used to teach patients discharged from a hospital on long-term anticoagulant therapy. Results indicate that much instruction was effective in achieving the desired results.

Evaluation of the Use of Programmed Instruction for Patients Maintained on Warfarin Therapy

Introduction

The purpose of this study was to develop programmed instruction to be used as a teaching tool by patients who were to be discharged from the hospital on long-term anticoagulant therapy. Oral anticoagulants are commonly used for the treatment and prevention of thrombosis and embolism. Safe, effective control of anticoagulant therapy depends upon comprehensive understanding of the pharmacology and side effects of the anticoagulant, knowledge of the antagonists available to control excessive effect when bleeding threatens or occurs, and proper utilization of the laboratory tests available for regulation of treatment. Persons most likely to benefit from long-term anticoagulant therapy include those with recurrent or migratory deep venous thrombosis, recent or recurrent myocardial infarction, recurrent episodes of pulmonary embolism, recent or remote cerebral vascular accidents, or repeated arterial embolism from an intracardiac site.¹

All oral anticoagulants, including Warfarin, act by depressing the production of at least two clotting factors, factor VII and prothrombin, by the liver.² The major complication of oral anticoagulant therapy is hemorrhage. Minor hemorrhage includes epistaxis, easy bruising, more than the usual amount of bleeding after brushing the teeth, prolonged bleeding after nicks during shaving or with other minor cuts, and microscopic hematuria. Major hemorrhage is defined as hematemesis, melena, cerebrovascular hemorrhage, severe bleeding from a wound, and massive hematuria.³

The content of the programmed instruction includes the action, effects, and administration of Warfarin, the most commonly used anticoagulant. Due to the potential therapeutic and side effects of Warfarin and the large population taking this anticoagulant, this drug is important enough to warrant the development of a program of instruction. The program could be made available to patients requiring teaching and would necessitate a minimum of medical and nursing intervention.

A number of factors have converged to bring health teaching into prominence. The greater effort in this century to maintain health rather than simply to treat disease has enlarged the sphere of knowledge an individual needs and demands a change in attitudes about health. There is an increase in long-term illnesses and disabilities, and both the patient and his family should possess a high degree of understanding of the illness and treatment.⁴

Successful long-term maintenance of anticoagulant therapy depends upon the patient's understanding of the ac-

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tion, effects, and administration of his prescribed anticoagulant.⁵ Helping patients to gain this understanding is a responsibility shared by physician and nurse. The American Nurses' Association includes teaching as a function of all nurses' private duty, general duty, public health, occupational health or office nursing.⁶ Kreuter⁷ identifies teaching of self-care or counseling on health matters to be one of the nursing operations needed to provide care. Lambertson⁸ characterizes nursing as an "educative process." Nursing and teaching are similar in that each involves a helping relationship that has as its objective the development of independence in the subject.

Essential patient teaching is frequently less than optimal. Curtis⁹ found up to 25 per cent of outpatients at a large metropolitan hospital erred in taking medications at home. Clinite and Kabat¹⁰ studied 30 patients who were instructed about their medications before discharge from the hospital. Only four took all the medications as prescribed. The study concluded that patients should be encouraged to be active participants in the educational process. Regarding Warfarin specifically, Udall¹¹ states that failure to take the medication exactly as prescribed is one of the most important causes of ineffective treatment. Some of the major reasons why hospital nurses do not teach are: lack of knowledge about content, inadequate knowledge of teaching skills and lack of skill in using them, and lack of responsibility in assuming the functions of a health teacher.¹² A method of instruction is needed that will provide a reliable source of information and actively involve the learner. Programmed instruction may be an optimal tool for teaching about health care.

Programmed instruction is a written sequential presentation of learning steps requiring the learner to answer questions about the material presented and telling him if he is correct or incorrect.¹³ Use of a program takes advantage of learning principles that are often difficult to apply with other teaching techniques particularly with a group of learners. It requires the learner to be active rather than passive. It provides immediate feedback, correcting his answer if it is wrong and reinforcing if correct. It allows the student to work at his own pace.¹⁴

No studies have been reported in the recent medical and nursing literature of the use of programmed instruction

in teaching patients about Warfarin therapy. However, programmed instruction has been effective in teaching patients content in several other areas. The Medical Foundation, Incorporated, of Boston, conducted a field study involving 184 diabetic patients. The purpose was to determine if programmed instruction was a useful method to teach diabetic patients about their disease. Using the branching method program and the Auto-Tutor Teaching Machine, all patients equaled or bettered their pre-program scores. The branching program offers the learner alternative paths from which to choose, and the path he takes depends upon the response he makes in each frame. Remedial information is given as necessary, and the learner progresses as quickly as he is capable.

Eighty per cent of the individuals completing the course felt it helped to increase their understanding of diabetes and self-care. Each patient stated he would recommend the teaching machine to other patients. Results showed that once a basic core of vital information is decided, the teaching machine is a useful method to foster patient learning. The wide range of ages, education, occupational classes, intelligence, and reading skills represented by those completing the course reflects the general applicability of this teaching tool.

Results of the use of programmed instruction in teaching diet to diabetic patients in Peoria, Illinois, suggested improvement of reinforcement and correlation of information given by individual members of the hospital team. The program presents the basic information in a new and different way, frees professionals for individualized counseling sessions with the patient, and may be used in the evening with families. Patients reported that the programmed instruction helped to integrate the diet information.¹⁵

All studies thus far have employed the use of a teaching machine in programmed instruction. However, the results of a study of 90 university students showed no significant difference in achievement between the group using teaching machines and the group using programmed texts.¹⁶ Freeman and Bulechek¹⁷ used a book type of program to teach dietary principles to renal dialysis patients. The patient and family could use the textbook at the most convenient time for them. Therefore, it appears that the content of the programmed instruction is more important than the method of presentation.

The purpose of this study was to develop programmed instruction on Warfarin to be used by patients to be discharged from the hospital on this anticoagulant. The hypothesis was that patients who participated in programmed instruction about Warfarin therapy would score higher on an objective test of their understanding of the use of the drug than either patients who read an information sheet containing the same factual content or patients who received no structured teaching.

Method

Subjects

Forty-five subjects over twenty-one and on Warfarin therapy were selected for study. All subjects were voluntary participants. Twenty-two males and twenty-three females, aged 21-77, comprised the sample. Criteria for subject

selection included the following: the patient is to be discharged on Warfarin; the patient is able to read, write, speak, and understand English; the patient is able to distinguish small type. The study was done at a large, midwestern university hospital.

The subjects were randomly assigned to one of three groups. Group I received programmed instruction booklets. Group II received a two-page handout information sheet. Group III received no specific printed or verbal instruction from the investigators. Group I was the experimental group. Groups II and III were the control groups.

Patients in Groups I and II were followed-up 24 to 72 hours after receiving instructional materials. At this time, the patient was asked to take the post-test. One subject refused to be tested and was eliminated from the study. Subjects agreeing to complete the quiz were allotted thirty minutes to complete the fifteen question, multiple-choice test. Patients in Group I were allowed ten additional minutes to complete a brief subjective questionnaire assessing program length, difficulty, and interest. The investigator was not present during the test but returned at the pre-determined time to grade the test with the patient.

Patients were asked to return the programmed instruction booklet or handout to the investigator before testing to reduce the temptation of using it during the test. All patients were given the handout sheet at the completion of their participation. They were encouraged to keep it for future reference and review.

Instructional Materials

The content of the programmed instruction was based on the results of a questionnaire sent to twenty-three physician specialists in cardiovascular diseases, information on anticoagulant therapy from the American Heart Association, and extensive library research.

The programmed instruction booklet consisted of fifty four-inch by five-inch pages in a ring notebook. The program was divided into five sections of approximately ten frames each. Content covered in each section included action and indication for use of the drug, laboratory testing, calculation of dosage, factors altering the effect of the drug, and safety factors. Each section was followed by a four-question quiz reviewing material covered in that unit.

Figure 1 illustrates the format of the linear type frame used in the booklet. The patient was instructed to cover the lower half of the page with the answer shield provided. After reading the information, he covered the frame with the answer shield and read the question. The patient wrote the answer on a separate answer sheet and flipped the page over for immediate feedback of the correct answer with explanations and remedial information. He then proceeded to the next frame. The hand-out sheet contained the same essential information as the program in two pages.

The post-test was based on the following four terminal behaviors expected at the completion of the programmed instruction booklet: a) the subject could identify the name and action of his anticoagulant medicine, b) the subject could identify two signs of undesirable effects of Warfarin; c) the subject could calculate the number of Warfarin tablets to take for a given dose and tablet strength; d) the subject could differentiate between desirable and undesirable practices relating to safety.

Figure 1—Typical Programmed Instruction Frame

19.

Warfarin should be taken at the same time each day so that you get into the "Warfarin habit." Your physician may suggest a time, such as lunchtime or bedtime. By taking Warfarin at a specific time, you will maintain a constant level of the medicine in your body, and you will be less likely to forget to take it.

Fill in the blank:

For most effective results, take your Warfarin at _____ each day.

Flip over

The best answer is at "the same time" each day. If you said "at breakfast," or "at bedtime," or "at dinner," you may be correct, but you should ask your physician at what time he recommends that you take your Warfarin.

Go to Frame 20

The test contained fifteen multiple-choice questions. Two questions had three possible answers, and thirteen questions had four choices. Only one answer was correct for each question. An internal homogeneity measure of reliability for this test using the Kuder-Richardson Formula 21 yielded a reliability coefficient of + .77 based on the forty-five subjects in the study. Therefore, the test items elicited fairly homogeneous responses from the participants.

In addition to the post-test, subjects in Group I were requested to complete an eight-item questionnaire. The questionnaire covered material pertaining to amount of material read, length of time to read the program, and recommendations for use by others. An eleven point-scale was used to evaluate length, difficulty, and interest in the program. Space was included for suggestions for improvement.

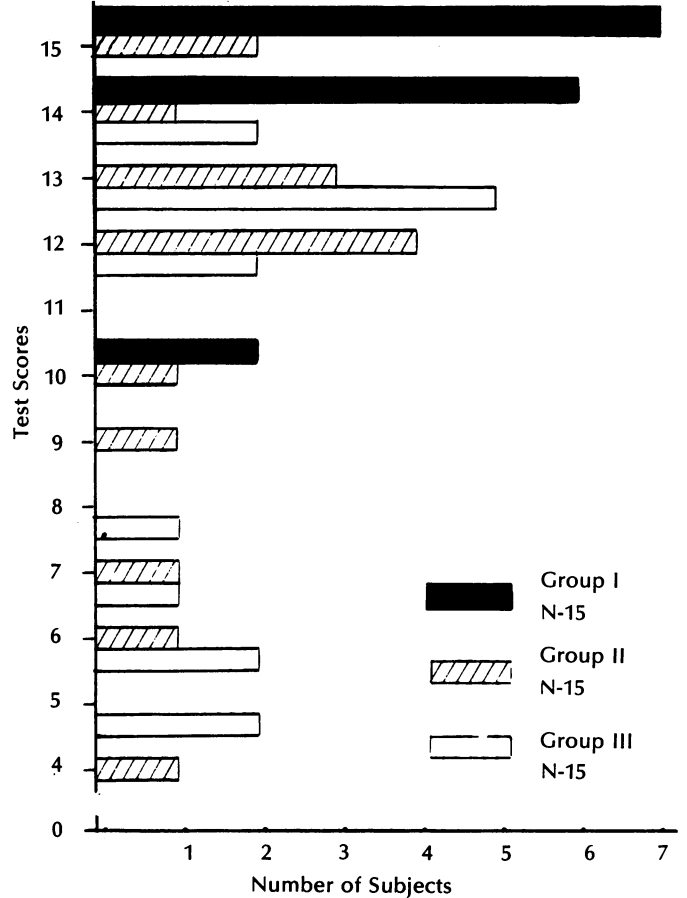
Results

The hypothesis tested in this study was that patients who participate in programmed instruction about Warfarin therapy will score higher on an objective test of their understanding of the use of the drug than either patients who read an information sheet containing the same factual content or patients who receive no structured teaching. Answers to a fifteen-item quiz support this hypothesis. Figure 2 compares the raw score frequency distributions for Groups I, II, and III. While seven subjects achieved a perfect score of fifteen points in Group I, only two subjects in Group II and no subjects in Group III answered all questions correctly.

Differences among the three groups are further reflected in Table 1. Group I had the highest mean test score; Group II had the second highest mean; and Group III had the lowest mean score.

In order to determine if these findings were significant, t-tests were done to compare differences between the

Figure 2—Frequency Distributions of Test Scores for Group I, II and III



means for Groups I and II, Groups I and III, and Groups II and III. Preliminary testing indicated a significant difference in the variance of the three groups. Therefore, the test scores were transformed to their sines to achieve homocedascity. The results of the t-tests on the transformed scores are shown in Table 2. An estimate of the strength of the difference between the various means, omega-squared (ω^2), is also given in Table 2.

The difference in mean test scores between Group I and Group II is significant and of moderate strength. The difference in teaching mode accounts for about 19 per cent of the variance between the two groups. The difference in mean test scores between Group I and Group III is also significant but weaker. Teaching versus no teaching accounts for only 11 per cent of the variance between the two groups.

When subjects were grouped according to sex, no significant differences were found between males and females on test scores.

Mean educational levels for the three groups were as follows: I - 11.5 years, II - 10.7 years, and III - 11.3 years. Comparison of these means yielded no significant differences. Both age and educational level were fairly evenly distributed across the groups and did not contaminate the results.

All subjects were also grouped according to whether or not they had taken oral anticoagulant medication prior to their participation in this study. Twenty-three subjects had taken Warfarin previously and twenty-two had not. As

Table 1—Means and Standard Deviations of Test Scores for Groups I, II, and III

Group	No.	Mean	S. D.
I	15	13.93	1.668
II	15	11.13	3.292
III	15	10.27	3.575
I, II and III	45	11.78	3.302

Table 2—T-Test and Omega-Squared Values for Test Scores of Groups I and II, I and III, and II and III

Groups	Mean sines of scores	t	df	w ²
I	0.627			
II	0.596	2.81*	28	.191
I	0.627			
III	0.145	2.20†	28	.113
II	0.596			
III	0.145	-.365‡	28	0

*p = .008 †p = .035 ‡p = .717

shown in Table 3, prior experience with oral anticoagulant drugs has no apparent impact on test scores. Mean test scores for experienced patients are equivalent to the mean scores for non-experienced patients.

All subjects in Group I completed a questionnaire to evaluate subjective aspects of the programmed instruction booklet. Program difficulty, length, and interest were assessed. On a 1 to 11 scale from "too difficult" to "too easy," the modal score was 7. The modal score was 5 on a 1 to 11 scale from "too long" to "too short." A modal score of 6 was found on a similar scale ranging from "very interesting" to "very boring." While the means of the first two evaluative factors were almost identical with the modes, the mean score from the last parameter was 8.4, over two points higher than the mode.

One subject with an eleventh grade educational level estimated that three or more hours were required to complete the program. Two subjects, each having had two years of college education, required less than one hour. However, the majority (N = 12) took one to two hours to complete the programmed instruction.

In reply to the question, "Would you recommend this programmed instruction booklet to your friends if they were taking Warfarin?," fourteen of the fifteen subjects replied, "Yes." One subject replied, "Maybe." Participants in Group I were also requested to suggest improvements in the booklet. Three subjects suggested clarifying or simplifying certain frames of the program. Three commented enthusiastically on its helpfulness to them. Eight participants offered no suggestions for change or improvement. One subject summarized the informal comments of many participants by writing, "Advertise it more!"

Discussion

These analyses indicate that hospitalized patients on oral anticoagulant therapy who participated in programmed

Table 3—T-Tests Comparing Previous Experience and No Previous Experience with Oral Anticoagulants Within Groups I, II, and III

Group	Experience with anticoagulants*	Mean test score	t	df	p
I	A	14.66			
	B	13.55	1.27	13	.22
II	A	11.57			
	B	12.00	.23	13	.81
III	A	10.60			
	B	9.60	.49	13	.62

*Note—"A" subjects had taken oral anticoagulants prior to their participation in this study.

"B" subjects had no prior experience with oral anticoagulants.

instruction about Warfarin learned significantly more about their therapy than individuals who received a handout information sheet or no instruction from the investigators. Age, sex, educational level, and previous experience with oral anticoagulants were fairly evenly distributed across the groups and do not, therefore, differentially influence the results.

One finding of particular interest was that patients in all three groups who had taken oral and anticoagulants prior to this study did not score significantly higher on the test of their knowledge of Warfarin than patients who had not previously been maintained on anticoagulant therapy. Thus, a premise of this study, that there is a real need for improved patient teaching, was supported. It appeared that very few patients who had taken Warfarin previously had received specific instruction during other hospitalizations or during clinic or office contacts with physicians or nurses.

The response of patients, nurses, and physicians to the programmed instruction booklet was most favorable. Patients were eager to read the booklet. Several family members expressed interest in the program. Nurses noted about patients involved with the study asked more questions about Warfarin and other medications.

The validity of this study would have been increased if the subjects' knowledge of Warfarin had been independently measured two or three times. It is recommended that future studies of teaching materials incorporate post-tests at one and six months after their initial use. Additional analyses of number of and reasons for clinic visits, hospital admissions, and success or failure of treatment could be considered.

Teaching materials, including programmed instruction, are intended to be an adjunct in teaching, not a replacement for the teacher. Motivation is best generated through interpersonal relationships. Supplementary, individualized health teaching by nurse or physician achieves a beneficial complement by extending the learner's sensory experiences, adding to his perceptions, and contributing new dimensions to his learning.

By offering approval for patients' learning activities and reinforcing instructional materials in her daily contacts with patients, the nurse can effectively stimulate voluntary learning through programmed self-instruction. Repetition and satisfaction strengthen learning.

Therefore, after completing the programmed instruction, the patient should be quizzed briefly, and his an-

swers reviewed and discussed. Approval and encouragement or simplification and tailoring to individual needs can be offered as needed. The patient should also be encouraged to take the instruction booklet home for reference and review and to share it with responsible family members.

These suggestions were applied by the researchers after formal data collection with all three groups. Patients expressed appreciation for feedback and individual attention. This was also a helpful means of informal evaluation of the instructional material.

The findings of this study parallel the results of many studies on the effectiveness of programmed instruction as an educational tool. Objective and subjective responses of patients to the programmed booklet on Warfarin therapy support the use of programmed instruction in health teaching. Similar programs could be developed to provide inpatients and outpatients with knowledge about specific illnesses, diagnostic procedures, and therapeutic regimens. Such instruction might be a first step toward putting responsibility for participation in health care in the hands of patients and their families.

Patient libraries could contain programmed instruction materials and related information that could be given to patients at the direction of physician or nurse. Nurses, dietitians, and occupational or physical therapists might use appropriate programs as adjuncts in teaching their clients procedures and skills. These could be used at the bedside or in the home, during the evening and on weekends, to extend the effectiveness of various health team members in a variety of health care situations.

Several problems for further investigation became apparent during this study. There are great differences in the education and experience of persons in need of health teaching. There are also differences in what individual physicians feel their patients should know about their health and therapy. Programs that are too general might frighten particular patients and complicate their care. The place and time in the disease-health continuum at which programmed instruction is most effective bears further study. Also, agreement must be reached on which members of the health team initiate instructional programs with specific patients.

It has been demonstrated that nurses with a minimal knowledge of programming techniques are able to write successful programmed instruction on content within their specialized field of knowledge. However, the question of who is the most qualified person or persons to develop programmed instruction for patient teaching also merits exploration.

It is recommended that more programmed materials be developed, evaluated, and made available for patient use. More experience is needed to solve the above problems satisfactorily. For this reason, the authors intend to revise and seek publication of their programmed booklet on Warfarin therapy. Pharmaceutical firms, government agencies, and voluntary health associations are probable sources of technical and financial support for the development of programmed materials for health teaching.

As programs are developed and made available in inexpensive pamphlet form, nursing practitioners and other health teachers will be able to give basic information to patients and families in self-instructional form and supplement this teaching with individualized discussion. They will also need to objectively evaluate the effectiveness and potential utilization of this medium in helping people recognize their health needs and understand ways of meeting them.

Summary

The results of this study indicate that programmed instruction is an effective method for teaching patients about the action, indications, and effects of Warfarin anticoagulant therapy. Patients who completed a fifty-frame programmed instruction booklet on Warfarin scored significantly higher ($p = .035$) on an objective test of their understanding of Warfarin therapy than control group patients who received no structured teaching from the investigators. The experimental group also scored significantly higher ($p = .008$) than patients who read a two-page handout information sheet containing the same basic concepts as the programmed booklet.

Subjective ratings by experimental subjects emphasized high interest in the method and content of the programmed booklet. It is recommended that more programmed materials be developed, evaluated, and distributed to inpatients and outpatients who need to learn about specific illnesses, diagnostic procedures or therapeutic regimens. Programmed instruction holds much promise for future health teaching since it requires active patient participation and allows more economical utilization of physician-nurse time for individualized instruction.

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