



## **Medical Education Booklet No. 17**

# **Preparation and presentation of patient-management problems (PMPs)**

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## Preparation and presentation of patient-management problems (PMPs)

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### Summary

This booklet offers some guidance to the teacher who wishes to produce patient-management problems for use with his students for teaching or assessment.

The producer should be familiar with the four phases of problems. The first phase is the provision of information about the patient, the second the request for some action from the respondent, the third the feedback to the respondent and the final phase the conclusion of the problem.

PMPs simulate reality and reproduce the decisions a doctor has to make in investigating and managing a patient. The respondent has to be involved actively in the problem.

This is facilitated by:

- (1) the use of the personal rather than impersonal, for example, 'You are called to see a man . . .' rather than 'Mr C. consults his doctor . . .';
- (2) the use of the present rather than the past tense;
- (3) provision of the results of the physical examination and investigation as they relate to the patient;
- (4) alteration of the patient's status according to the actions taken by the respondent. (This may be possible only with computer-based PMPs).

A range of media can be used to present problems including print, audiotape, slides, filmstrip, microfiche, overhead projector transparencies, videotape, film, computers, models and simulated patients. Each technique has advantages and disadvantages.

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### Introduction

The following are four examples of the use of patient-management problems in medical education.

(1) Doctors sitting a postgraduate examination are given in their written paper a description of a patient who presents with acute abdominal pain and loss of weight. They are asked to make decisions about the patient's investigation and management, by selecting from lists, further information about the history, the physical examination or the laboratory investigation. The doctor reveals the results by rubbing a chemical-impregnated felt-tip pen over the paper adjacent to his selection. He then bases further decisions on the results revealed, and the examiner can see later which responses the doctor has made.

(2) At the beginning of a course on endocrinology, undergraduate students are given a set of notes containing a series of problems each relating to a patient with an endocrine disorder. The students are asked a number of questions relating to each problem. For example, in the case of a young man with a single lump in the thyroid, they are asked what further information they would want, how they would investigate the patient and the most likely diagnoses. The students have to direct their studies in endocrinology so that they can tackle the problems with which they have been presented.

(3) A group of general practitioner trainees watch, with a trainer, a videotape of a patient who consults her doctor with the complaint of headaches. At various points in the videotape instructions are given to the observers to stop the tape and discuss, as a group, the issues brought out in the consultation and to decide how they would proceed with the interview. When they have completed their discussions they restart the tape and continue with the consultation.

(4) A student sits in front of a microcomputer. On the monitor there are details of a boy who has been admitted, collapsed and shocked, to the hospital emergency department. The student has to choose from a range of investigative and management options. He can review the patient's pulse rate, blood pressure, respiratory rate and level of consciousness at any time. The patient responds to the treatment prescribed. Suddenly the student reads on the monitor 'Your patient has now had a cardiac arrest'.

Patient-Management Problems, or PMPs as they are frequently referred to, are exercises which simulate the decisions a doctor has to make in the diagnosis and treatment of a patient's illness. By imitating a real situation, PMPs allow a student to practise, assess or be evaluated on an aspect of clinical competence, without the use of patients.

In recent years, medical teachers have made increasing use of such problems both as a focus for students' learning and as an assessment instrument in formal examinations or in self-assessment exercises (Barrows & Tamblyn, 1980). The use of PMPs has a number of advantages. They direct the learning and assessment towards more practical and relevant aims. They encourage in the student more complex thinking and help develop problem-solving skills. As well as being motivating, PMPs can make learning more efficient by providing a situation round which the student can build his knowledge, as in the case of a patient seen by the student in the clinical context.

Print has been the medium most widely used to present such problems to students and indeed some workers have restricted the use of the term 'PMP' to written simulations. In a previous ASME booklet Marshall & Fabb (1981) looked at one strategy for preparing such problems in print and in another booklet Knox (1975) described another approach to printed simulations, the modified essay question. The present booklet describes the range of media that can be used to present PMPs and provides an overview of approaches to the production of PMPs for intending authors, together with some practical guidelines.

### Stages in a PMP

PMPs develop in stages, each stage corresponding to a stage in patient management. In a consideration of the production and presentation of PMPs it is useful to look at these stages or phases of a problem. They are:

- (1) information is provided about the patient and the problem;
- (2) some action is required of the respondent;
- (3) feedback is provided to this action;
- (4) the PMP ends.

The first three phases may be repeated many times before the end of a problem is reached. (See Fig. 1.)

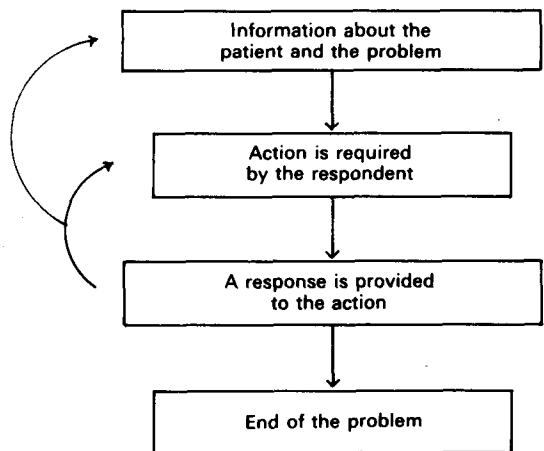


FIG. 1. Stages or phases in a patient-management problem.

#### Phase 1. Information about the patient

The first stage in a PMP is the presentation to the respondent of information about the patient and the problem. This sets the scene for the problem and provides sufficient information for the respondent to come to some informed decision about the patient. This information usually includes a description of:

(1) the nature of the problem. This might be, for example, the sudden onset of chest pain, a recent bereavement in the family, or the finding of a raised blood-pressure reading on an insurance examination. Some of the patient's presenting clinical features might be described.

(2) how the problem presents. For example, the patient may present to his practitioner as an emergency or his wife might telephone the general practitioner for an appointment to see him.

(3) further details about the patient including age, sex, previous medical history, family history and social history and background.

(4) a description of the medical care setting, for example, urban or rural, distance to hospital and medical facilities available.

### *Phase 2. Action required by the respondent*

Once the respondent has been given some initial information about the patient he is asked to make decisions or to take some action in relation to the patient's diagnosis or management. For example, the respondent may take further history from the patient, carry out a physical examination or order laboratory investigations. PMPs are often characterized by the way in which the respondent is asked to take such action or make decisions. There are essentially three variants—the linear and branching structured problems and the open problem (See Fig. 2.) Each type will be described in turn.

(1) In the *linear structured problem* the respondent is taken through a series of decisions he has to make about the problem. An outline of an example is given in Fig. 3 and a more detailed extract is given in Appendix 1. The questions can require a prose answer or a constructed response. An example is:

'What investigations would you now order?'

The respondent can be given a clue as to the extent of the answer required. For example,

'What are the three most likely diagnoses?'

This style of question is used in the examinations of the Royal College of General Practitioners (Knox, 1980).

Alternatively the question can be of the multiple-choice format in which the respondent has two or more choices: for example,

'Which of the following investigations would you arrange now, in this patient.

- (a) Serum thyroxine
- (b) Serum TSH
- (c) Serum triiodothyronine
- (d) Thyroid scan
- (e) TRH test.'

(This type of question has been discussed in *ASME Medical Education Booklet No. 10* [Harden, 1979]).

A variant of this is the type of question in which instead of a simple 'yes' or 'no' decision, for each choice the respondent has to rate the course of action or statement on a one-to-five scale, one being something which should certainly not be done or

something certainly wrong, two something that should probably not be done or is probably wrong, three an equivocal action or decision, four something that should probably be done or is probably correct and five something that should certainly be done or is certainly correct. This type of question has been used in both written PMPs (Harden *et al.*, 1979) and computer-based PMPs (Murray, Dunn *et al.*, 1977; Murray, Cupples *et al.*, 1977).

In a PMP the type of question can be varied and different types may be used in the same problem. Multiple-choice questions impose more constraints on the respondent but are easier to mark.

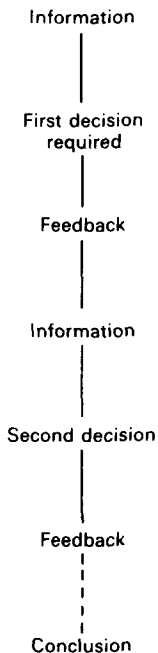
(2) The *branching-structured type of problem* is similar to the linear-structured type in that all students are faced with the same decisions. In this type, however, at each decision node the respondent's route to the next question depends on his answer to the previous one, and the response he receives will depend on his answer to the question (Fig. 2).

In the example in Fig. 4 the respondent is faced with a number of choices as to the diagnosis. In a self-assessment exercise or where the problem is being used as an aid to learning he is then given feedback in relation to his choice. If he makes the correct response, (a) in this case, he has this confirmed and is then referred onto the next stage. If he makes an incorrect response as in (b), (c) or (d) he is given an explanation and is referred back again to the question. At the next stage of the problem he has to choose one or more investigations to be carried out. After each investigation he is given the result and is then referred back to make a further choice should he wish to do so. When he has completed his investigation he is referred to the next stage of the problem. In a self-assessment exercise the appropriateness of each investigation may be commented upon. After the respondent has completed his choices the recommended selection of tests may be reviewed.

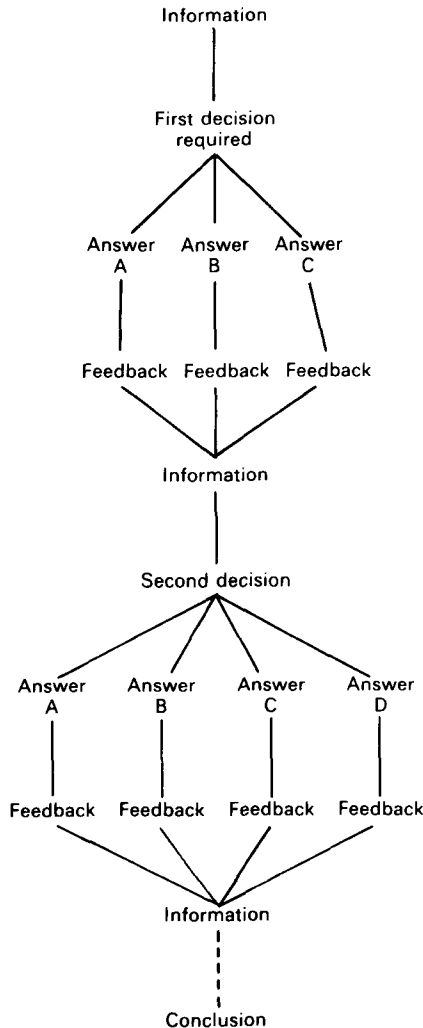
The questions have to be of the multiple-choice type to accommodate the branching. After each question and response, the student is returned once again to the main path through the problem as imposed by the structure predetermined by the author.

(3) In the *open type of problem* the student determines his own path through the problem. The student can make his own choice as to what he chooses to do next, for example one student might choose to take a further history from the patient while another might choose to carry out a physical

## 'Linear structured'



## 'Branching structured'



## 'Open type'

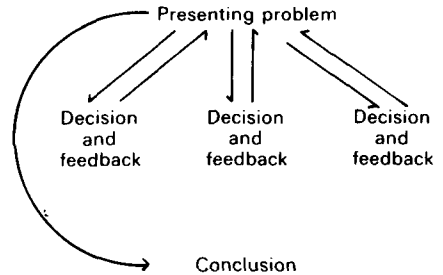


FIG. 2. Three types of patient-management problems. In the linear structured type the respondent is taken through a series of decisions. In the branching structured type he is taken through the same decisions but at each decision node he has a number of options. He is then given feedback to his own decision before proceeding to the next stage of the problem. In the open type the respondent chooses which decisions he wishes to make and the order in which he will make them.

examination and a third might arrange some laboratory investigations. Questions do not have a prose answer, as in the structured-linear type, but instead are of the multiple-choice type where the student is provided with a menu of the choices of action available to him. Some items on the menu may lead to a further selection of choices.

In the example shown in Fig. 5 the first sorting

frame directs the student either to history, physical examination or laboratory investigation. A further sorting frame then explores which aspect of history, physical examination or laboratory investigation he wishes to explore.

An extract from an open type PMP is given in Appendix 2.

While to some extent the listing of choices provides

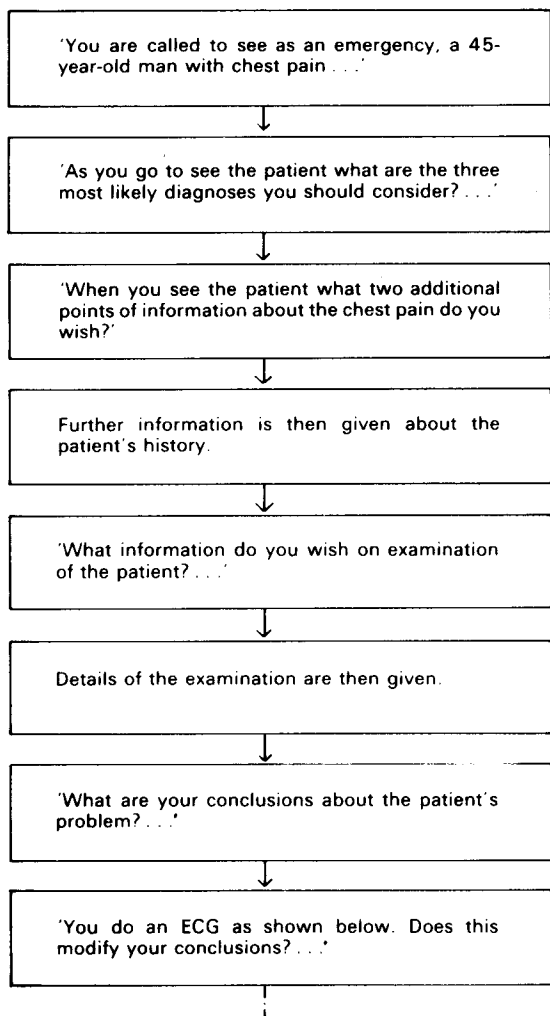


FIG. 3. Extracts from an example of part of a linear structured problem.

the student with a prompt, this type of problem provides the student with more freedom of action than the structured type of problem. It is this type that has been used by the American Board of Medical Examiners (Hubbard, 1978) and by the Australian College of General Practitioners (Marshall & Fabb, 1981).

*Types of action.* In each type of problem the action required of the respondent can include:

- (1) collection of further information through
  - (a) a history from the patient,

- (b) a history from relatives or associates,
  - (c) a physical examination of the patient,
  - (d) laboratory and radiological investigations;
- (2) interpretation of the information, for example, the respondent can be asked to prepare a list of the patients problems or to draw some conclusions or form some hypothesis or diagnosis about the patient;
- (3) management of the patient, for example,
  - (a) education of the patient,
  - (b) advice to relatives,
  - (c) drugs,
  - (d) diet,
  - (e) referral of the patient for a specialist opinion,
  - (f) follow-up of the patient.

### *Phase 3. feedback to the action*

*Types of feedback.* After he has taken some action, the respondent is given feedback. This can be either of the following.

(I) Feedback as to whether his action was appropriate or not. In a problem intended as a self-assessment exercise the respondent can be given information which will allow him to compare his own action with that expected of him by an expert. For example, in a problem of a patient with clinical features suggestive of hypothyroidism, an example of questions and feedback is given below. The questions are not cued.

'What further examination should be made?'

'Examine the patient to see if there is a goitre. This provides useful information relevant to establishing the cause of the hypothyroidism.'

On examination the patient was found to have a small firm goitre.'

'What three possible diagnoses should you consider at this stage?'

- (1) Autoimmune thyroiditis
- (2) Drug induced goitre
- (3) Dysphormonogenesis

The following is an example of feedback in the problem of a patient with clinical features of thyrotoxicosis. The questions are cued.

'What investigations would you now arrange?'

- (1) Serum thyroxine
- (2) Serum triiodothyronine
- (3) Serum TSH'

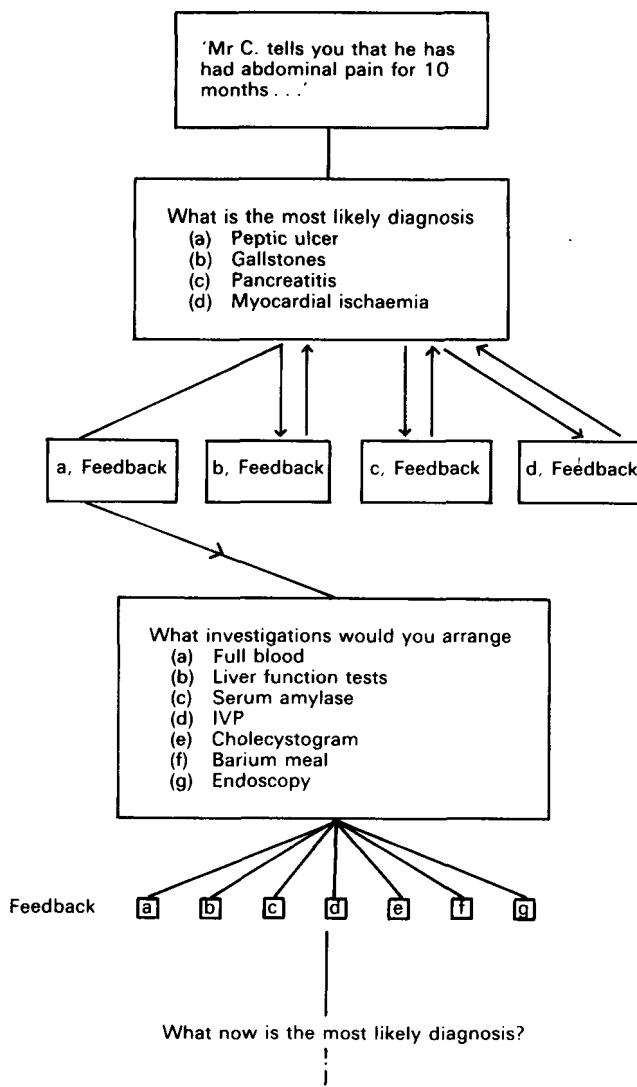


FIG. 4. Example of outline of frames from a branching structured problem.

(1) Little would be gained by repeating the serum thyroxine estimation. Two previous values are normal and it is unlikely to have changed.

(2) The serum triiodothyronine should be estimated. The patient may have T3-toxicosis. In this condition the serum triiodothyronine may be raised although the serum thyroxine is normal.

(3) The serum TSH is of no value in establishing a diagnosis of thyrotoxicosis.'

The respondent may also be given information as to the action taken by colleagues who have tackled

the problem previously. In one set of PMPs used by about 10 000 General Practitioners in Britain as part of a continuing medical education programme, the opportunity to compare their own performance with that of a hundred of their colleagues who had already tackled the problem was perceived, by those who took part, as one of the most valuable features (Harden *et al.*, 1979).

(II) Information which would have been obtained in reality by questioning or examining the patient or carrying out laboratory investigations. The respon-

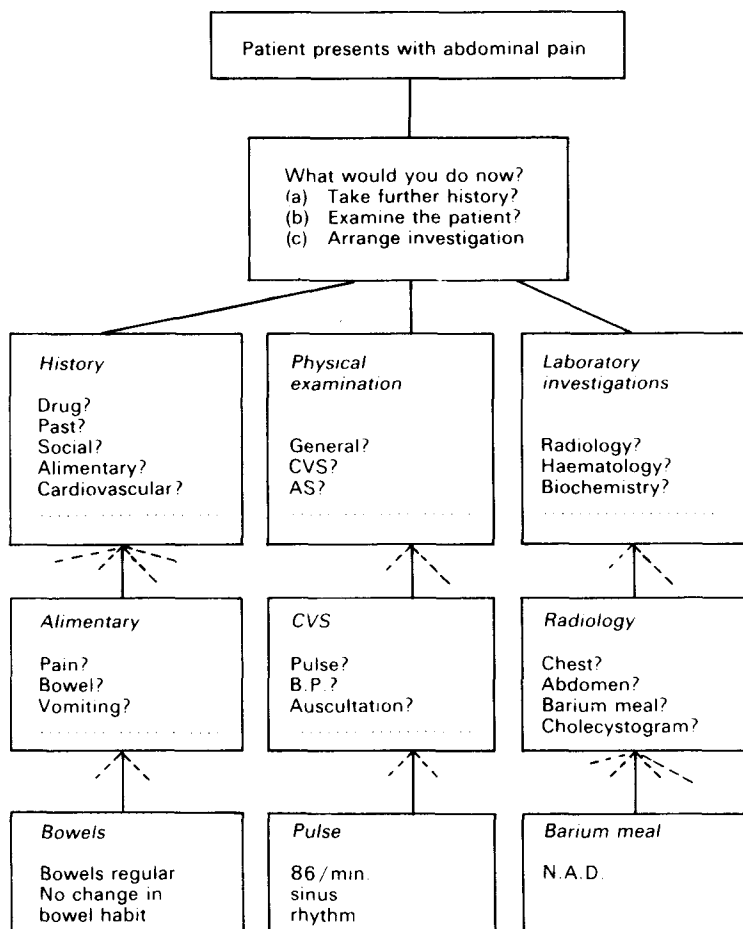


FIG. 5. Outline of frames in 'open' PMP. The respondent chooses which information he wishes and the order in which he requests it.

dent is given the answers to questions he asks on the history, the findings on physical examination of the patient or the result of investigations ordered.

If the action involves some management decision, the patient's response to this may be provided.

**Hidden feedback.** In a PMP the feedback is usually hidden in some way so that the respondent does not see the results of an action until he has committed himself to it. Premature revealing of the feedback by a respondent may invalidate a problem. While this is particularly important where PMPs are used as an instrument for formal assessment, it is also the case where the PMP is used for self assessment or as an aid to learning.

A number of methods have been used in printed

PMPs to hide the feedback from a respondent until he has committed himself to a course of action.

(1) A simple approach is to have the feedback on the following page. The respondent is instructed not to turn to the new page until he has written his answer on the previous one. Once having written his answer he is not allowed to change it. This approach has been used in the examination of the Royal College of General Practitioners in the U.K.

(2) The feedback can follow on the same page, separated by a line from the question, or it can occupy a second column on the page. The feedback can be covered with a mask by a respondent until he has come to a decision. This technique is limited to where PMPs are used as self-assessment exercises and examples can be seen in journals where space is at a



premium and the size of the page cannot be altered so that each answer is on a new page.

(3) Feedback can be provided on a later page. The temptation is for the student to look at more than one answer when he turns to the answer page. This can be avoided by arranging the answers in random order, each answer being numbered. The student is referred to the appropriate answer by a number after each question. As with the previous technique this is not appropriate for use where the PMP is used as a formal assessment tool.

(4) One of the most effective approaches to hiding the feedback is the use of latent-image printing. With this technique the feedback is printed with a chemical in such a way that it is not visible until it is treated by the respondent with a felt-tip pen impregnated with another chemical. Once it is treated it remains visible and cannot be erased. PMPs can be prepared using this technique in large or small quantities and offset printing and duplicating techniques can be used (Rogers *et al.*, 1979; 1980). Some printers such as A. B. Dick specialize in the technique, and undertake the printing or supply materials for local production.

(5) An alternative to the use of latent-image printing is the use of scrambled printing. In this approach the answer is hidden by letters overprinted in a different colour. The feedback is revealed by superimposing a transparent mask of the same colour as the overprinted letters. Where a permanent record is required a felt-tip pen of the same colour can be used instead of a mask (Marshall & Fabb, 1981). Scrambled printing has been used extensively in self-assessment exercises in the postgraduate journal *Update* and can be produced for local use with a standard typewriter (Cairncross & Harden, 1983).

(6) Other techniques include various mechanical methods where the answer is revealed by scraping away a protective covering. This approach has been largely superseded by latent-image printing. The future will almost certainly see the development of further techniques such as the use of cholesteric crystals which respond to temperature and which reveal the answer temporarily if the temperature is changed by rubbing a warm thumb over the feedback (Cairncross & Harden, 1983).

#### *Phase 4. The conclusion of the problem*

The final phase is the conclusion of the problem. In a structured problem it corresponds to the last ques-

tion. In an open problem it is when the respondent has completed his task. Thus in the case of a diagnostic problem, it is when he feels he has carried out sufficient investigations to come to a diagnosis. Where the problem is a management one in which the patients' status alters according to the respondents actions, the problem can terminate either when the patient improves or when he dies. In self-assessment exercises this last phase of the problem might include a brief résumé of the problem with the views of one or more experts as to how they would have investigated or managed the patient. The respondent can then compare his own actions with those of the experts.

#### **Media used to present the PMP**

While print is the most widely used medium to present PMPs, a range of media can be used. This section looks at media and the characteristics relevant to the presentation of PMPs.

Media available include:

- (1) print;
- (2) audiotapes;
- (3) slides;
- (4) filmstrip;
- (5) microfiche;
- (6) overhead projector transparencies;
- (7) videotape;
- (8) film, sound and silent;
- (9) computers;
- (10) models;
- (11) simulated patients.

While each medium will be examined separately, in practice two or more may be used to present a PMP, for example, slides and audiotape may be used for the first phase, the presentation of a problem, and a computer may be used to present the later phases of the problem.

#### *Print*

There are good reasons why print has been the medium most extensively used to present PMPs. It is relatively inexpensive to prepare and can be produced economically in large or small quantities. For the user or respondent it has the advantage that no special equipment is required and it can be distributed easily by post. Text can be supplemented by prints of X-rays and ECGs or coloured prints of patients. Where the number of copies is small, the coloured illustrations can be presented as photogra-

phic prints, each print being numbered to correspond to the appropriate section of the text. Alternatively the prints can be attached to the text, at the appropriate places with adhesive.

Packs or sets of cards, instead of pages, can be used to present the PMP (Barrows & Tamblyn, 1977). Each card contains on one side the type of information to which the card refers, for example, history of chest pain, or X-ray of chest. By turning over the card, the respondent obtains the results of the investigation in the patient, for example, if he turns over the card 'History of chest pain' he may read 'Mr X. gives no history of chest pain'. As the cards are not marked by the students, they can be used repeatedly by different students.

*Special printing techniques.* Reference to the use of special printing techniques was made in the section describing the third phase of PMP. The purpose of this is to hide the feedback from the student until he has committed himself to a course of action. For assessment exercises, latent-image printing, in which feedback is developed by the student using a chemically impregnated felt-tip pen, is most useful although scrambled text has also been used for this purpose. While the permanency of the revealed image in latent-image printing is an advantage for formal assessment purposes, for self-assessment exercises it is a disadvantage in that the exercise can be used on only one occasion.

*Disadvantages of print.* While print has many advantages as a medium for PMPs it also has some disadvantages.

(1) It is usually more difficult to simulate reality with print than with other media. For example, a written account of a patient's history may not seem as real as hearing it from the patient. In other situations, for example, in a PMP based on a patient's case record or a letter from a colleague about a patient, a written PMP can be as real as any medium.

(2) It is sometimes difficult in a written problem to avoid giving the respondent clues or prompts which detract from the exercise. A written description of a patient's hypothyroid voice or facies may lead the student to the diagnosis which he might have missed if he had simply seen the patient or a videotape of the patient. When a patient is first seen, the initial clues are often perceived instantly and sometimes unconsciously by the doctor. It is difficult to simulate this in a written PMP without excessive prompts.

(3) Print is not the ideal medium when the PMP has to be tackled by a group rather than by an individual. With print it is difficult to focus all the group's attention on the same section of the problem and the rustling of pages as they are turned may be distracting.

Despite these potential disadvantages, print is likely to remain the most widely used medium to present PMPs.

### *Audiotapes*

Audiotape can be used on its own or, more commonly, with a visual such as print, slides or microfiche. It can be used to reproduce a patient's history as given to a doctor, or a conversation between two doctors. In some situations such as a simulated telephone conversation, no visual is required.

Audiotape is useful for the first phase of a PMP to present the initial problem but less so in the later phases.

### *Slides*

Slides are a useful method of presenting, relatively inexpensively, coloured photographs of a patient or results of laboratory investigations. They can be projected onto a screen for group use or used by individuals in a study booth (Biran & Harden, 1982) or with hand viewers (Harden *et al.*, 1970). Back projection systems are available and these have the advantage that a group can look at the slide without darkening the room. In self-assessment exercises or learning programmes, the feedback to an action can be hidden on the next slide and this is not revealed until the respondent has committed himself to a course of action.

A random-access projector can be used to present PMPs and the respondent can view any of the eighty slides in the magazine by pressing the appropriate numbers on the keypad (Harden, 1982). Each slide represents one item of information. In structured branching problems, the slides are looked at in sequential sets, and in open problems the respondent takes whatever path he wishes through the slides with the aid of sorting slides which point him to the various branches in the hierarchy. (See Fig. 5.)

In formal assessment, the slides can be used to introduce the problem and may be presented to the class as a group. In this situation it is important, however, to ensure that the details on the slides can

be seen by all the students no matter where they are sitting in the room.

### *Filmstrip*

Filmstrip can be used in the same way as slides. The strips can be viewed by individuals with simple inexpensive viewers and reproduction of the filmstrips may be less expensive as mounting is not required. Projection of filmstrip is usually more difficult than with slides as equipment is not readily available in medical schools or postgraduate centres.

### *Microfiche*

Microfiche, like filmstrip, can be used as a substitute for slides. It has the advantages that it is more compact, sixty to eighty frames being stored on one microfiche. In large quantities it is less expensive than with slides and, with suitable equipment, changing from frame to frame may be quicker. Random-access microfiche readers are available and these allow any of sixty frames to be viewed. Such viewers may be linked to a tape-player which controls the frame changes. Microfiche viewers, however, are less readily available than slide viewers and in small quantities the production of coloured microfiche is more expensive than slides and like filmstrip can less easily be changed or updated once a programme has been completed.

### *Overhead projector transparencies*

On first reflection this may seem an unlikely medium for the presentation of PMPs. Overhead projector (OHP) transparencies do, however, offer some advantages, in particular where a problem has to be tackled by a group of students. The problem is presented on the first OHP transparency or using some other medium such as audiotape and slides or a printed handout. Choices of action available to the respondent and feedback to the action is recorded on subsequent transparencies. The OHP can be used to present structured problems or open-type problems. In the case of open-type problems, sorting frames lead the respondent into the more detailed information as in the case of slides (Fig. 5). Thus the set of transparencies represents a data bank containing all the available information about the patient.

More than one piece of information can be recorded on one transparency. For example, a list of

available biochemical investigations can be recorded on the left side of a frame, and the results of the investigations recorded on the right opposite each test. The results are covered by a hinged mask which is opened to reveal the answers.

While for individual students the use of the OHP to present PMPs is somewhat cumbersome, for a group of students, small or large, with a leader or teacher, the technique has much to recommend it. It is particularly appropriate for the one-off production of problems for local use.

### *Videotape*

Videotape has several advantages. It can present movement and allows situations such as a doctor-patient consultation to be reproduced. It also links together audio and visual channels in one medium.

Videotape can be used to present the problem in both structured and open problems. In structured linear problems, the videotape is stopped at decision points where some action is required of the student. When the student or group of students have completed their decisions the videotape is restarted. Interactive video systems in which the player is linked with a microcomputer have been developed and offer considerable potential for PMPs.

### *Films*

Much of what has been said about videotape also applies to film, either 16mm or 8mm.

A recent development which has some applications for PMPs is a relatively inexpensive super 8mm silent projector with an integral back-screen projection system and which can be programmed to stop at pre-arranged points.

### *Computers*

In the past decade increased use has been made of computers to present PMPs. The development of the micro-computer has meant that the teacher and student are no longer dependent on access to a main-frame computer and has increased greatly the potential use of the computer for this purpose. The computer's strength lies in its ability to:

- (1) provide the respondent with quick easy access to any information about the patient on file;
- (2) modify the patient's clinical status or progress according to the action taken by the student;

(3) introduce a time element into the problem so that actions taken by the student have a time penalty;

(4) keep a record of the student's decisions and, where indicated, award a mark or rating to the student.

Thus the computer is, in many ways, the ideal medium for the second and third stages of the PMP where the student is making decisions and is getting a response to his decisions. It is less efficient in presenting the initial information about the patient. For this purpose other audiovisual media can be used. Techniques are now available which allow the micro-computer to be linked with a slide projector, microfiche reader or a video-cassette player.

### *Models*

Models or simulators may be incorporated into a PMP. They are available covering a range of physical findings such as vaginal examination, rectal examination or examination of the breast. The model can be prepared in advance with the appropriate pathology such as fibroids and the respondent can examine the model at the appropriate stage as he works his way through the problem.

### *Simulated patients*

A PMP can be presented to a student as a simulated patient. The simulated patient is rehearsed with the relevant history and is questioned by the student as he would a real patient. An accompanying case record can give details of laboratory investigations for the patient and a letter of referral may be used to present the problem. Cater has used the technique in the Department of Child Health in Dundee to present to students problems which they might not otherwise encounter. Examples are the mother of a battered baby, the parents of a child with Down's syndrome or the mother whose baby has a terminal

illness. This use of simulated patient as a special type of PMP is not discussed further in this booklet.

### **Considerations in the choice of medium**

A number of factors need to be taken into account when the medium to present a PMP is chosen. These are:

- (1) the ability to communicate the necessary information to the respondent;
- (2) use for learning or for assessment;
- (3) use by individuals or with groups;
- (4) ease of use;
- (5) ease of production;
- (6) ability to present 'branching' or 'open' problems;
- (7) ability to vary patient's position with the respondent's action.

Some of the characteristics of the audiovisual media are summarized in Fig. 6.

#### *Ability of medium to communicate the necessary information to the respondent*

The first requirement is that the medium is capable of conveying the information required to the respondent. In a PMP, sufficient detail has to be given to allow the student to make realistic decisions about a particular patient. This is easier with some media such as a videotape than with others such as print where a full description may, in some instances, be too tedious and does not provide a good simulation of reality. In some situations a colour photograph may be required to show the facial appearances or a piece of film to show an abnormal gait. In other situations the written word may be adequate to present the necessary information.

	Communication of information				Allows random access	Allows interaction between the patient's status and respondent's action
	Audio	Visual	Movement	Photographs		
Audiotape	+	—	—	—	—	—
Slides	—	+	—	+	+	—
OHP	—	+	—	—	+	—
Microfiche	—	+	—	+	+	—
Videotape	+	+	+	+	—	—
Films	+	+	+	+	—	—
Computer	—	+	—	—	+	+

FIG. 6. Some characteristics of audiovisual media which can be used to present PMPs. Only principal characteristics are noted.

*Use for learning or for assessment*

An important consideration in the choice of medium or method of presentation is whether the problem is to be used as part of a course of instruction, as a self-assessment exercise or as an instrument for formal assessment.

Where the PMP is to be used in formal assessment it is important to choose a method which:

(1) allows the examiner to have a permanent record of the student's responses and path through the problem. This may be a written prose answer, developed latent-image print or records on the computer.

(2) prevents the student from seeing, prematurely, feedback to the action until he has committed himself to a course of action.

*Use by individual or with groups*

Problems can be designed primarily for use with individual students or doctors or with groups in a lecture theatre or small group discussion. The choice of medium should reflect the intended use. Thus while printed problems are suitable for doctors working on their own, they are less suitable where problems are presented to groups.

*Ease of use*

There are clear advantages if the problem can be used by the students without the need for special equipment such as a video-cassette player or micro-computer. For this reason problems presented in print have a clear advantage over problems presented with other media. Printed problems can be used by the student when and where he wishes and can be sent by post to be used by doctors at home as part of a continuing education programme. There may well be situations, however, where the advantages of using print have to be sacrificed for the advantages inherent in other media.

*Ease of production*

Whatever medium is chosen, problems require some expertise in their construction, in presenting information about the patient, in building in decisions to be made by the respondent and in providing feedback. Some media however, require less skill and facilities to develop them than others. Paper and pencil problems for individual use, or OHP transparencies for group use can be produced by any teacher for use in his own teaching with the minimum of resources.

*Ability to present 'branching' or 'open' problems*

In structured branching programmes or open programmes the respondent requires to access one from a number of different frames. While this can be achieved with print, where the number of alternatives is large the end result may appear to the respondent cumbersome or complicated. Random-access slide or microfiche projectors or computers provide access for the respondent to one of a large number of frames on pressing the appropriate key.

*Ability to vary patient status with respondent's actions*

In some problems it is an advantage if the patient's status can alter depending on the respondent's management decisions. For practical purposes this can be achieved only through the use of a computer.

**Strategies in choosing media**

In coming to a decision about which medium or media to use for a PMP the teacher can adopt one of the following strategies.

(1) The teacher first decides the type of problem to be developed and the topics to be covered. An outline of the different phases of the problem is then produced. Taking into account the various criteria described above, the most appropriate medium is selected for each phase. For example, the initial information may be presented as a doctor-patient interview on videotape with the patient's previous records on paper, and a micro-computer and slides may be used to present the later phases of the problem.

While this approach might be perceived as representing the ideal, it does have some disadvantages. The media chosen may not be readily available, while others might be easily available to the respondents. The combined use of several media may be expensive in terms of production and requirements for use and the potential user may feel inhibited if use of the PMP appears to him complicated.

(2) The second approach is to look at the main or essential requirements of the problem and choose the single most appropriate medium. For example, if the problem concerns interpersonal skills and doctor-patient interaction, then videotape may be chosen as the medium even although it does not provide all the flexibility of feedback that might have been wished in the later stages of the problem. If decision making is the most important task, then the computer may be

chosen in the knowledge that one has to sacrifice the impact of colour photographs for the advantage of more interaction with the respondent.

(3) The third approach is to look at the resources readily available to those who will be using the problems and to tailor the problems to suit. For example, if the respondents are expected to tackle the problems in their own home, then the choice may be paper and pencil; if random-access projectors are available and being used by the students then it might be worth while developing some PMPs to be used on them. If the students have ready access to a micro-computer and one wishes to encourage their use of it, then some PMPs could be developed for the computer.

(4) A fourth approach is to choose a method with which the teacher already has personal experience.

### How to set about producing your first PMP

One thing is certain. You will never produce a PMP unless you make an attempt to do so. While much can be learned from reading about the subject in booklets such as this or from examining other peoples PMPs, at some stage the teacher must attempt to write his own problems. There is no one best way to set about the task or one best medium to adopt. Having read this booklet and by following the guidelines below, however, any teacher will be able to develop PMPs for use with his own students. With practice and by trying out the problems with students the quality of the PMPs will be improved.

To start with choose paper and pencil as the medium and try to produce a structured problem. It is sometimes helpful to model the problem on a patient seen recently. Use A5 sheets of paper. On the top half of the first sheet describe briefly the patient's complaints and how he presents, together with some background information about the patient. If you are doubtful as to what information to include read again the section in this booklet on phase (1) of the problem, and look at the examples given in the Appendices. Now consider the various stages and thought processes that you would go through in coming to a diagnosis and managing the patient. At each decision point or node ask the student what provisional conclusions he has come to or what he would do next in terms of eliciting further information about the patient or managing the patient.

After you have given details of the presenting problem, you can ask about the respondent's prelimi-

nary conclusions. You can ask an open-ended question such as 'What is the most likely diagnosis?' or 'Which of the following diagnoses would you consider most likely?

- (1) myocardial infarction;
- (2) pulmonary embolism;
- (3) pleurisy?

Type the question in the bottom half of the first page. On the top half of the second page:

(1) give the 'correct' answer to the first question (if the problem is to be used as a self-assessment exercise or as part of a learning programme);

(2) provide any additional information you may wish to give at this stage.

On the bottom half of the page ask the next question, for example, 'What further questions would you ask the patient?' This pattern is repeated throughout the history taking, physical examination, etc. The types of actions you might ask about are described in the section on Phase (2) of the problem, 'Action required by the respondent'.

On each sheet type the next question on the bottom half of the page and the answer and further information about the patient on the top half of the next page.

For further examples see *ASME Booklet No. 5* (Knox, 1975).

The following are some suggestions for preparing PMPs of the open type where the emphasis is on diagnosis.

List on a 6"×4" card the areas of relevance in the history, for example, family history, history relating to cardiovascular system, etc. Number these 1 to *n*. An example is given in Appendix 2. Name the card 'History sorting card'.

Prepare a 'history system card' for each system identified on the history sorting card, for example, cardiovascular system, alimentary system, etc. On this card list questions to be asked relating to the system. Number the questions 1 to *n*.

For each question prepare a card with the question to be asked on the front and the answers on the back. Number these cards according to the numbers on the sorting cards. For example,

- 4.3 Abdominal pain
- 4.4 Bowel movement
- 5.2 Chest pain
- 5.3 Breathlessness

Repeat this procedure for physical examination, then for the investigations. Examples of sorting cards are given in Appendix 2. Different coloured cards can be

used for history, physical examination and further investigations.

For further examples see *ASME Booklet No. 12* (Marshall & Fabb, 1981).

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### Appendix 1: example of a structured PMP

The following example has both linear and branching elements.  
The clinical presentation

In the branching frames the answer is hidden in some way on the same page or is on a different page.

1. David is a 14-year-old boy who is brought to your surgery by his parents. He has a history of chronic cough which has kept him awake at night. It is unproductive of sputum. There is no obvious cause for the cough and examination of his nose and pharynx is negative.

The next frame is a branching one

2. What would you do?	
2.1 Prescribe a course of antibiotics	2.1 In the absence of any evidence of infection antibiotic treatment is unlikely to be helpful.
2.2 Prescribe a cough suppressant	2.2 If the child has an unproductive cough which is disturbing him and there is no obvious cause, a prescription of a cough suppressant is not an unreasonable course of action. Arrangements should be made to review his progress if there is no improvement.
2.3 Reassure and give no treatment	2.3 Although no treatment than reassurance is a possible approach, many doctors would prescribe a cough suppressant. The cough has kept him awake at night and there is no obvious cause for it.
2.4 Refer to hospital clinic	2.4 There is no indication to refer this boy to a hospital clinic.

The next frame is a linear one.

3. David is given a cough suppressant.  
He returns to see you 2 weeks later.  
He is no better and on direct questioning gives a history of wheezing and breathlessness.  
What further points should be elicited in the history?
- The following points should be elicited.
- (a) Are there any symptoms related to contact with house dust or exposure to grass pollen? In this case the answer is yes. His mother thinks his symptoms are worse in the house.
  - (b) Time of day of attacks. If they occurred mainly during the night, this might suggest an allergy to house dust or feathers from bedding. David's attacks occurred mainly in the morning.
  - (c) Are his attacks seasonal? If they occur mainly during the summer months, this may suggest a pollen allergy. There was no seasonal history in this case.
  - (d) Are the attacks related to exercise? Asthma may be induced in some patients by certain forms of exercise, for example, running.  
David indicated that he sometimes sneezed after playing football.
  - (e) Is there a chronic nasal infection? This might indicate chronic nasal sepsis.  
There was no such history in David's case.

The next frame is another branching frame

4. On the history so far would you conclude
- |  |   |
|--|---|
| 4.1 He has an allergic (atopic) asthma | 4.1<br>Yes. The likely diagnosis in David's case is allergic asthma in view of the presence of a personal history of wheezing on effort and a possible relation of attacks to exposure to house dust. |
| 4.2 He has sinusitis                   | 4.2<br>No. There is no evidence to support a diagnosis of sinusitis, although only a detailed examination of the naso-pharynx could positively exclude this.  |
| 4.3 He has neither of the above        | 4.3<br>No—try again.  |

5. What investigations would help you confirm your diagnosis?
- Prick testing
  - Exercise testing
  - Full blood count
  - Sputum examination
  - Chest X-Ray
  - Blood sample for blood gases

A later section of the structured problem. A linear frame.

22. How would you treat him?

23. David's treatment consisted of
- (1) Regular prophylactic sodium cromoglycate
  - (2) Inhaled sympathomimetics when he requires them
  - (3) He and his mother were advised about the avoidance of allergen.



The problem develops further. Another linear frame.

24. One evening you are called to see David. He has become wheezy during the day and has not responded to his usual dose of bronchodilator. A repetition of the dose has not helped. On examination he is restless, but not cyanosed. His pulse rate is 120/min. On listening to his chest you hear widespread wheezes and he is very anxious. You reassure him and give him a slow intravenous injection of 250 mg of aminophylline. He shows no improvement.

What would your management be?

25. You send him to hospital having given him 100 mg hydrocortisone IV in addition to 30 mg prednisolone orally.

## Appendix 2: example of an open-type problem

The patient's presenting complaint is provided

*Joe Brown*

45 years. 168 cms. 80kg. Married. 5 children aged 7–16 years. Smokes 30/day. Heavy drinker.

Former coalminer—now office worker.

Acute myocardial infarction 18 months ago.

Convalescence uneventful but lipid abnormality—high cholesterol, high triglycerides.

Consults G.P. four times this month:

- (1) Diarrhoea—clears by itself.
- (2) Indigestion—clears.
- (3) Three-day history of upper abdominal pain and nausea and vomiting. (Advised to drink less and eat frequent small meals.)
- (4) Pain continues, radiates to back and right hypochondrium.

The respondent has to decide what he wishes to do.

*A general sorting frame*

Take a history from the patient

go to 1.0

Carry out a physical examination

go to 2.0

Arrange further investigations

go to 3.0

The respondent then proceeds according to his decision at the previous frame.

*The history sorting frame*

1.1 Past medical history

go to 1.1

1.2 Drug history

go to 1.2

1.3 Family history

go to 1.3

1.4 Social history

go to 1.4

*The history sorting frame cont.*

1.5 History relating to cardiovascular system	— { go to 1.5 }
1.6 History relating to respiratory system	— { go to 1.6 }
1.7 History relating to alimentary system	— { go to 1.7 }
1.8 Haemopoietic system	{ go to 1.8 }
1.9 Central nervous system	— { go to 1.9 }
1.10 Genito-urinary system	— { go to 1.10 }
1.11 Endocrine system	— { go to 1.11 }
1.12 Locomotor system	— { No swelling of joints, stiffness or pain. }
1.13 Skin	— { No rashes, pigmentation or stick. }

1.1  
 Uneventful until acute myocardial infarction 18 months ago.  
 Found at this time to have a lipid abnormality (elevated cholesterol, high triglycerides). Accepted Grade I for Life Insurance Policy when aged 24. Recent tendency to winter colds—does not interfere with his time at work.

1.2  
 'Askit' powder for headache, on average once weekly.  
 (contains 750 mg aloxypirin). Alcohol intake—6 pints and 2 measures of whisky three or four times a week.  
 'Aludrox' prescribed 2 weeks ago to be taken between meals.

1.3  
 Married. Five children aged 16, 14, 11, 9, and 7 years.  
 Father died aged 50 years with coronary thrombosis.  
 Mother aged 70 years, alive and well.  
 No other family history of coronary artery disease.  
 No family history of alimentary disease.

1.4

Miner. Took up office job in pit after coronary thrombosis.

(Previously worked at coal face.)

Resultant drop in income.

Since then problems appear to have increased. Two oldest children in trouble at present.

Lives in three-bedroomed, terraced house. With wife working and adequate budgeting, should be able to cope financially.

Heavy alcohol intake—6 pints and 2 measures of whisky, three or four times a week.

Smokes 30 cigarettes/day.

## History relating to one system.

## 1.5 History relating to cardiovascular system

- |                        |   |
|------------------------|---|
| 1. Dyspnoea            | Dyspnoea on moderate exertion since his coronary. No accompanying symptoms. No orthopnoea or paroxysmal nocturnal dyspnoea. |
| 2. Chest pain          | Occasional ache in the praecordium especially when stressed, but no definite pain.  |
| 3. Oedema              | No findings of note.  |
| 4. Palpitations        | Occasional palpitations in bed, usually after social evening.   |
| 5. Faints or dizziness | No findings of note.  |
| 6. Calf pain           | No findings of note.  |
| 7. Cold extremities    | No findings of note.  |
| 8. Weight loss         | Weight constant last few years and since onset of illness.  |

## Another history frame for a system

## 1.7 History relating to alimentary system

- |                        |  |
|------------------------|--|
| 1. Pain                | Abdominal pain present for 6 days. Mainly epigastric but radiates through to back and (R) hypochondrium.<br>Pain is constant and continuous but has not interfered with sleep.<br>Improves when has a few drinks at social club.<br>Accompanied by nausea and vomiting.  |
| 2. Nausea              | Nausea throughout present illness.<br>Continuous but aggravated by food.   |
| 3. Vomiting            | Has tended to vomit after meals. Amount varies but always contains undigested food.<br>Never any blood in vomit.   |
| 4. Flatulence          | No history of belching or flatulence.  |
| 5. Water brash         | Water brash occasionally occurs after a night's drinking at social club.   |
| 6. Appetite and weight | Appetite poor since onset of present illness. Afraid to eat as may precipitate further bouts of sickness.<br>Weight constant.  |
| 7. Bowels              | Bowel function usually regular.<br>Recent diarrhoea cleared by itself.<br>No constipation.<br>No rectal bleeding.  |
| 8. Swallows            | No difficulty in swallowing.   |
| 9. Heartburn           | Occasionally aware of heartburn, especially when lying down.   |
| 10. Diet               | Breakfast: tea and toast.<br>Break snack at work.<br>Main meal around 4 p.m. Usually consists of moderate helping of meat or pie, beans, large helping of chips or potatoes. Custard.<br>Cup of tea.<br>Found low cholesterol diet unpalatable.<br>Since illness, has taken frequent small meals with antacid between meals. |

Frames 1.6 and 1.8 to 1.12 are omitted from this example.

*Physical examination frame*

2.0	Physical Examination	
2.1	General condition and appearance	Medium build. Comfortable at rest but appears tense. Does not look ill. Face slightly flushed but otherwise appears normal. Conjunctivae well injected. No pigmentation. No evidence of jaundice. No cyanosis. No oedema.
2.2	Skin	No abnormality.
2.3	Head and neck	No abnormality.
2.4	Eyes	No evidence of exophthalmos or squint. Fundi normal.
2.5	Nose	Both nostrils clean. Breathes through nose.
2.6	Mouth	No fissuring of mouth. Tongue normal. Teeth carious -require attention.
2.7	Lymph nodes	No evidence of lymph node enlargement.
2.8	Hands	No evidence of clubbing or joint swelling.
2.9	Temperature	98.4°F
2.10	Pulse	76/min. Regular
2.11	Blood pressure	115/75
2.12	Praecordium	Apex beat normal. Heart sound pure. No evidence of cardiac failure.
2.13	Chest	Chest—symmetrical Trachea -central Percussion -normal Breath sounds -vesicular with a few scattered crepitations throughout both lung fields.
2.14	Abdomen	Normal contour—moves normally on respiration. Tender in epigastrium on palpitation. Liver palpable 1-finger breadth below costal margin. No spleen or kidneys palpable. No hernia. Normal bowel sounds. P.R. negative.
2.15	Central nervous system	Cranial nerves intact. No other abnormality detected.
2.16	Joints	No abnormality detected in joints.

*Investigations sorting frame*

3.0	Investigations	
3.1	Haematology	{ go to 3.1 }
3.2	Biochemistry	{ go to 3.2 }
3.3	Bacteriology	{ go to 3.3 }
3.4	Blood grouping	{ go to 3.4 }
3.5	Radiology	{ go to 3.5 }
3.6	ECG	{ N.A.D. }
3.7	EEC	{ N.A.D. }

*Example of investigation frame*

3.2 Biochemistry	
1. Urea and electrolytes	Urea 4.1 m mol/l (25mg%) Electrolytes N.A.D.
2. Liver function tests	AST, $\gamma$ -GTP & Alkaline Phosphatase slightly raised.
3. Cholesterol	9.1 m mol/l (350mg%) fasting (normal levels 7.8 m mol/l [300mg%])
4. Triglycerides	2.85 m mol/l (230mg%)
5. Calcium & phosphate	N.A.D.
6. Lipoprotein electrophoresis	Broad pre-B band (abnormal)
7. Glucose	8.3 m mol/l (150mg%) fasting
8. Serum thyroxine & T <sub>3</sub> uptake	Thyroid function N.A.D.
9. Uric acid	0.48 m mol/l (8mg%) (upper limit of normal 0.89m mol/l [6.5mg%])
10. Amylase	420 iu/l (upper limit of normal 300iu/l)

*Another investigation frame*

3.5 Radiology	
1. Chest X-Ray	[ N.A.D. ]
2. Barium swallow and meal	[ N.A.D. ]
3. Abdomen X-Ray	[ N.A.D. ]
4. Barium enema	[ N.A.D. ]
5. Cholecystogram	[ N.A.D. ]
6. I.V.P.	[ N.A.D. ]
7. Skeletal survey	[ N.A.D. ]