

## Commentary

# An agenda for UK clinical pharmacology Public understanding of drug therapy

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Knowing some basic principles about medicines would help patients to understand drug therapy and to help and encourage them to use it well. These principles relate to the categories and names of drugs, their different uses, how they reach the site of action (absorption, distribution, fate), how they produce their effects, both beneficial and harmful, the time courses of drug actions, how the pattern and intensity of the effects of a drug depend on dose and timing, drug interactions, how drug effects are demonstrated and investigated and sources of information and their trustworthiness.

These basic principles are an essential part of health literacy and understanding them would enable individuals to comprehend better the information that they are likely to receive about medicines that they will take. Different populations need different types of education. For schoolchildren, the principles could fit into biology and domestic science teaching, starting in the later years of primary school or early in secondary school. A teaching package would also be needed for their teachers. For adults, web-based learning seems the most practical option. Web-based programmes could be supported by the NHS and professional bodies and through public libraries and local community health services. Specific groups for targeting could include young mothers and carers of chronically ill people. For retired people, one could envisage special programmes, perhaps in collaboration with the University of the Third Age. Conversations between patients and professionals would then become more effective and help shared decision making.

## Introduction

To be able to choose appropriate drug therapy, and to use it effectively and safely, requires understanding of some basic general principles about medicinal products and their uses, and how to apply these principles in considering particular medications.

Few members of the general public are aware of these principles, and so they cannot think sensibly or coherently about drugs. They have to depend on what they hear from prescribers or allied professionals, or what they read or hear from other sources, the reliability of which they cannot judge. The huge gap between professionals and patients in understanding health and illness is the greatest barrier to shared decision making, which should be offered to all patients who want it. However, discussions about this fundamental problem in health care have focused on 'informing' patients and the public, and have not addressed the need to *educate* people and make them '*health literate*'. 'Information' cannot be used by people who lack adequate 'information receptors', i.e. the ability to assimilate and process the information to their advantage. The structure and brevity of

consultations allow no systematic teaching of the underlying principles.

## Principles

The principles about which the public need to be educated are listed in Box 1.

### *Categories and names of drugs*

Drugs are not logically categorized [1]. Nevertheless, knowing, for example, that atenolol and propranolol are both  $\beta$ -adrenoceptor blockers (named after their pharmacological action) and that amoxicillin and co-amoxiclav both contain penicillin antibacterial drugs (named after the organism from which the first penicillins were obtained) can be of help.

The names of drugs can be complicated and sometimes hard to pronounce and remember. Resulting confusion can lead to medication errors. However, it is useful to know that drugs have brand names and non-proprietary names, that the latter are often more informative than the former, but that sometimes the former need to be used instead.

**Box 1**

The principles of drug therapy about which members of the public should be educated

Categories and names of drugs
The different uses of drugs
How drugs reach the site of action (absorption, distribution, fate)
How drugs produce their effects, both beneficial and harmful
The time course of drug actions
How the pattern and intensity of the effects of a drug depend on dose and timing
Drug interactions
How drug effects are demonstrated and investigated
Sources of information and their trustworthiness

*The different uses of drugs*

Patients are not always aware of the reason for taking a medication, and it can be helpful to explain which of the following uses are relevant:

- preventive – to prevent illness or harms to health or well-being (for example, prevention of infections, prevention of anaemia in pregnancy);
- supportive – helping to maintain bodily function;
- symptomatic – to relieve or attenuate symptoms;
- curative – to cure a disease or condition;
- diagnostic.

*How drugs reach the site of action*

Knowing how and in what form a drug enters and leaves the body involves knowing that drugs are absorbed, distributed and eliminated, and that these events determine the pattern of effects and time course of action of a medication.

*How drugs produce their effects and the time course of drug actions*

This includes knowing that the effects of a medication are determined by its actions on various organs and functions of the body, the time course of these actions and the context of its use, for example, what the person expects and believes about it. These effects vary from person to person and can rarely be accurately predicted for an individual. Careful explanation of this may usefully modify an individual's expectations.

Both prescribers and patients need to be well informed about the nature and timing (i) of the intended effects of the drug and (ii) of its possible harmful or inconvenient effects, to enable them to weigh the expected benefits against the possible disadvantages. Knowing the effects of *not* taking a medicine can be as important as knowing about its benefits.

The professional contributes more knowledge in weighing up the balance of benefits and harms, but in the

end what is decisive is how the patient values each outcome, including its quality, intensity and duration, in striking the balance. The better the prescriber and the patient understand each other, the better the outcome.

*Drug interactions*

Knowing that drugs can interact with each other can help the patient understand the need to seek advice when other therapies are introduced.

*How drug effects are demonstrated and investigated*

It is important to stress that fair comparisons are essential [2]. This includes comparing the drug treatment with what happens without it, minimizing biases and estimating statistically the likely role of chance in reaching the results. Patients also need to understand that anecdotal experience is often evidentially weak.

*Sources of information and their trustworthiness*

Information about medicines is widespread on the internet and much of what is available is of poor quality. Patients can benefit from being pointed to reliable sources of information.

*Treatment guidelines and recommendations*

Guidelines, such as those published by the National Institute of Health and Clinical Excellence (NICE), are largely based on evaluation of randomized controlled clinical trials (RCTs). In addition cost-effectiveness is often also taken into account. Since RCTs are essentially comparisons of groups of people given different treatments, they predict only the average effect to be expected. This means that in some people the effect will be greater and in others less. Awareness of this will help patients understand that the outcome that they experience may not be the same as the average expectation. If the individual turns out to be much more or much less sensitive to the drug than average, the guideline may not apply.

**Applying the principles**

Applying the principles requires some knowledge of the disease or problem to be treated, and how and in what circumstances the drug can influence it [3]. Both positive and negative effects of the drug need to be considered, to be able to weigh the estimated benefit against the possible or likely harms from it. Benefits and harms will vary with the dosage, duration and temporal pattern of use of the drug, and these are aspects that deserve discussion between prescriber and patient.

**How can we get there?**

First we must distinguish between information and education: people without information receptors, i.e. who are not

**Table 1**

hebasic principles (column 1) applied to atenolol (column 2); column 3 gives the most nearly corresponding items in the current UK leaflet for atenolol 25 mg (Tenormin®) prepared by AstraZeneca in 2007; some parts of the text have been shortened (adapted from Herxheimer [4])

Principle	Applied to atenolol	Current leaflet (prepared 2007)
<b>Medicines are of many different kinds: what kind of medicine is it?</b>	Atenolol belongs to the group of medicines called beta-blockers.	Tenormin contains a medicine called atenolol. This belongs to a group of medicines called beta-blockers.
<b>Treatment may be symptomatic, curative, or preventive, or may help to maintain normal function; whichever it is determines when, how often, and for how long a medicine is used.</b>	Atenolol is usually a maintenance treatment; it helps to make and keep the function of the heart and circulation more normal. After a heart attack it is used to prevent irregular heart rhythms.	Tenormin works by making your heart beat more slowly and with less force. It is used to: <ul style="list-style-type: none"> <li>• Treat high blood pressure (hypertension).</li> <li>• Treat uneven heart beats (arrhythmias).</li> <li>• Help prevent chest pain (angina).</li> </ul>
<b>Knowledge is insufficient about many aspects of drug treatment. Likely benefit must be weighed against risks of harms and inconvenience before the treatment is begun, and reconsidered in the light of its effects in the individual case.</b>	Atenolol reduces high blood pressure, and helps to prevent angina (chest pain coming from the heart). It can also control heart beats that are irregular or too fast, and help to protect the heart after a heart attack.	<ul style="list-style-type: none"> <li>• Protect the heart in the early treatment after a heart attack (myocardial infarction).</li> </ul> Do not take Tenormin if: <ul style="list-style-type: none"> <li>• You are allergic (hypersensitive) to atenolol or any of the other ingredients of Tenormin 25 mg Tablets (see Section 6: <i>omitted here</i>).</li> <li>• You have ever had any of the following heart problems: <ul style="list-style-type: none"> <li>– heart failure which is not under control (this usually makes you breathless and causes your ankles to swell);</li> <li>– second- or third-degree heart block (which may be treated by a pacemaker);</li> <li>– very slow or very uneven heart beats, very low blood pressure or very poor circulation.</li> </ul> </li> <li>• You have a tumour called phaeochromocytoma that is not being treated. This . . . can cause high blood pressure. If you [have] a phaeochromocytoma, your doctor will give you another medicine, called an alpha-blocker, to take as well as Tenormin.</li> </ul>
<b>The inconveniences and risks of not using the medicine should also be considered before starting, and again after its effects have become evident. Medicines can produce harmful effects</b>	<p>The risks of not using atenolol are those of the complications of uncontrolled high blood pressure which include stroke and heart attack.</p> <p>Atenolol can make asthma worse, and is therefore avoided in people with asthma or chronic bronchitis. It can slow the heart too much, and may cause tired muscles, general tiredness, and cold hands and feet. These are more likely to occur, and to be troublesome, with the higher doses.</p>	<ul style="list-style-type: none"> <li>• You have been told that you have more acid than normal in the blood (metabolic acidosis).</li> </ul> Do not take Tenormin if any of the above apply to you. If you are not sure, talk to your doctor or pharmacist before taking Tenormin. <p><b>Possible Side Effects</b> Like all medicines, Tenormin can cause side effects, although not everybody gets them.</p> <p><b>Allergic reactions:</b></p> <p>If you have an allergic reaction, see a doctor straight away. The signs may include raised lumps on your skin (weals), or swelling of your face, lips, mouth, tongue or throat.</p> <p><b>Other side effects:</b></p> <p><b>Common (affects less than 1 in 10 people)</b></p> <ul style="list-style-type: none"> <li>• Your pulse rate may become slower while you are taking the tablets. This is normal, but if you are concerned please tell your doctor about it.</li> <li>• Cold hands and feet.</li> <li>• Diarrhoea.</li> <li>• Feeling sick (nausea).</li> <li>• Feeling tired.</li> </ul> <p><b>Uncommon (affects less than 1 in 100 people)</b></p> <ul style="list-style-type: none"> <li>• Disturbed sleep.</li> </ul> <p><b>Rare (affects less than 1 in 1000 people) [omitted here]</b></p>
<b>Knowing how drugs get into the body, and how they may reach the place or places where they act, helps to decide by what route to give the drug.</b>	Absorption needs no special mention for atenolol, but one could say 'it acts on the heart, which it reaches through the blood stream'.	.
<b>The body gets rid of drugs by excreting them, or by changing them into inactive substances, which are then excreted. If this happens quickly the drug acts briefly, if only slowly it may act for a long time. The duration of action helps to determine the frequency of dosing.</b>	Elimination and duration of action deserve mention: 'Atenolol is excreted in the urine; one dose acts for 8 to 24 h, so one or two doses a day may be needed.' One could add: 'In people with poor kidney function one dose may act for much longer, so one dose every few days may be enough.'	.
<b>The appropriate dose is not the same for everyone, and sometimes it needs to be changed</b>		<p>Always take Tenormin exactly as your doctor has told you. You should check with your doctor or pharmacist if you are not sure.</p> <ul style="list-style-type: none"> <li>• Your doctor will tell you how many tablets to take each day and when to take them. Read the label on the carton to remind you what the doctor said.</li> <li>• Swallow your Tenormin tablet whole with a drink of water.</li> <li>• Try to take your tablet at the same time each day</li> </ul>

**Table 1**

Continued

Principle	Applied to atenolol	Current leaflet (prepared 2007)
Some medicines can alter the effects of other medicines; this can result in unwanted effects.	Various other medicines, e.g. antiarrhythmic drugs, ACE inhibitors, can increase the effect of atenolol on blood pressure; other drugs, e.g. some analgesics can reduce the effect. The doctor should therefore check other medications.	
The bigger the dose taken, the bigger the effect (up to a ceiling), and the longer it lasts; and, very important, the greater the variety of different effects, most of them unwelcome. This influences the dose chosen, and at what intervals to take the medicine.	Doctors often begin treatment with 25 mg day <sup>-1</sup> , the lowest dose that can be effective. If necessary, the dose can be increased, either by using 25 mg twice a day or 50 mg once a day. Should this not be enough, 100 mg day <sup>-1</sup> can be used. The higher the dose, the greater the chance of unwanted effects, so consult your doctor if you experience unpleasant or unexpected effects.	<b>Adults</b> <ul style="list-style-type: none"> <li>• <b>High blood pressure (hypertension):</b> the usual dose is 50 mg to 100 mg day<sup>-1</sup>.</li> <li>• <b>Chest pain (angina):</b> the usual dose is 100 mg a day or 50 mg twice a day.</li> <li>• <b>Uneven heart beats (arrhythmias):</b> the usual dose is 50 mg to 100 mg day<sup>-1</sup>.</li> <li>• <b>The early treatment of a heart attack (myocardial infarction):</b> the usual dose is 50 mg to 100 mg day<sup>-1</sup>.</li> </ul>
People differ in their sensitivity to a drug: in some a small dose produces the expected effect, in others even a large dose may do little. A person may be very sensitive to one drug and fairly insensitive to another. Alcohol and caffeine are everyday examples.	Elderly people, and those who are thin or weigh little, usually need only small doses of atenolol; women may need smaller doses than men.  No one can tell before you start taking atenolol exactly what dose will be best for you, so after your doctor has seen how the drug has affected you it may be necessary to increase or reduce the dose.	<b>Elderly people</b> If you are elderly, your doctor may give you a lower dose, particularly if you have problems with your kidneys. <b>People with severe kidney problems</b> If you have severe kidney problems your doctor may give you a lower dose. <b>If you take more Tenormin than</b> prescribed by your doctor, talk to a doctor or go to a hospital straight away. Take the medicine pack with you so that the tablets can be identified. <b>If you forget to take</b> a dose of Tenormin, take it as soon as you remember. However, if it is almost time for the next dose, skip the missed dose. Do not take a double dose to make up for a forgotten dose. <b>Do not stop taking Tenormin without talking to your doctor.</b> In some cases, you may need to stop taking it gradually.

properly educated and cannot assimilate and process health information to their advantage, are at a disadvantage.

The simplest basic approach is to integrate the principles with the information, that is, to make them an inseparable part of Patient Information Leaflets (PILs) and perhaps of Summaries of Product Characteristics (SmPCs). That would facilitate fruitful discussions between patients and professionals, such as pharmacists, nurses and doctors. In 1995, after the European Directive on the contents of PILs had been translated into national regulations, I pointed out that they neither mentioned any of the principles nor supported good conversations between patients and professionals [4]. I suggested a revised version of the PIL for atenolol, in order to illustrate how one might incorporate the principles in it (Table 1). In designing PILs it is anyway high time to put the interests of patients and health professionals first. For instance, the overwhelming repetition of the brand name in PILs is obtrusive and absurd.

Separate programmes to educate the public to understand and apply the principles require much more effort and resources, but we need to consider what methods are worth trying for different target groups.

For schoolchildren, the principles could fit into biology and domestic science teaching, starting in the later years of primary school or early in secondary school. A teaching package would also be needed for their teachers.

For adults, web-based learning seems the most practical option. Web-based programmes could be supported by the NHS and professional bodies and through public libraries and local community health services. Specific groups for targeting could include young mothers and carers of chronically ill people.

Since retired people could benefit disproportionately from better understanding of medicines, and have more time, one could envisage special programmes for them, perhaps in collaboration with the University of the Third Age (U3A) [5].

Although print and broadcast media also have an important role, frothy news appeal and editorial values can sometimes work against real understanding. In recent years, the work of the Science Media Centre has done much to improve this form of communication [6].

## Conclusions

The public is woefully ignorant about medicines and their uses. Clinical pharmacologists and their allies can and should change this. A 5 year plan to this end is highly desirable.

## Competing Interests

There are no competing interests to declare.

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