Handbook of Evidence-based Veterinary Medicine

Peter D. Cockcroft MA VetMB MSc DCHP DVM&S MRCVS
Mark A. Holmes PhD, MA, VetMB, MRCVS
Epidemiology and Informatics Unit
Department of Clinical Veterinary Medicine
University of Cambridge

Handbook of Evidence-based Veterinary Medicine

Peter D. Cockcroft MA VetMB MSc DCHP DVM&S MRCVS
Mark A. Holmes PhD, MA, VetMB, MRCVS
Epidemiology and Informatics Unit
Department of Clinical Veterinary Medicine
University of Cambridge

© 2003 by Blackwell Publishing Ltd

Editorial offices:
Blackwell Publishing Ltd, 9600 Garsington Road, Oxford OX4 2DQ, UK
Tel: +44 (0)1865 776868
Blackwell Publishing Inc., 350 Main Street, Malden, MA 02148-5020, USA
Tel: +1 781 388 8250
Blackwell Publishing Asia Pty Ltd, 550 Swanston Street, Carlton, Victoria 3053, Australia
Tel: +61 (0)3 8359 1011

The right of the Author to be identified as the Author of this Work has been asserted in accordance with the Copyright, Designs and Patents Act 1988.

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, except as permitted by the UK Copyright, Designs and Patents Act 1988, without the prior permission of the publisher.

First published 2003 by Blackwell Publishing Ltd
Reprinted 2006

ISBN-10: 1-4051-0890-8
ISBN-13: 978-1-4051-0890-4

Library of Congress Cataloging-in-Publication Data
Cockcroft, Peter D.
Handbook of evidence-based veterinary medicine/Peter D. Cockcroft, Mark A. Holmes.
p. cm.
Includes bibliographical references (p.).
ISBN 1-4051-0890-8 (alk. paper)
1. Veterinary medicine–Handbooks, manuals, etc. 2. Evidence-based medicine–Handbooks, manuals, etc. I. Holmes, Mark A. (Mark Adrian), 1959- II. Title.

SF748.C635 2003
636.089–dc21

2003048075

A catalogue record for this title is available from the British Library

Set in 10/12pt Optima
By DP Photosetting, Aylesbury, Bucks
Printed and bound in Great Britain
by TJ International Ltd, Padstow, Cornwall

The publisher's policy is to use permanent paper from mills that operate a sustainable forestry policy, and which has been manufactured from pulp processed using acid-free and elementary chlorine-free practices. Furthermore, the publisher ensures that the text paper and cover board used have met acceptable environmental accreditation standards.

For further information on Blackwell Publishing, visit our website:
www.blackwellpublishing.com

DEDICATION

For Elizabeth, Edward and Simon (PDC)

For John and Pandora, my parents without whom I wouldn't have been able to write this book, and for Henry, my son, who made it worth writing (MAH)

Contents

Preface xiii
Acknowledgements xiv

1 Introduction 1
1.1 Who is this book for? 2
1.2 Who isn't this book for? 2
1.3 What do we mean by EBVM? A brief description 3
1.4 Comparison of the traditional methods and EBVM 4
1.5 Why should we practise EBVM? 4
1.5.1 Because we can 4
1.5.2 Because our clients can too 5
1.5.3 We need the information 5
1.5.4 Time for learning, a diminishing resource faced with expanding demands 8
1.5.5 Increasing the speed of adopting the results of science 8
1.5.6 To better direct clinical research 9
1.5.7 Ethical aspects of proof 9
1.5.8 Ethical conduct in the absence of scientific evidence 10
1.5.9 A return to science 11
1.5.10 Are we ready to ask questions about our own performance? 11
1.6 A more detailed description of EBVM 11
1.6.1 The process 11
1.6.2 The need for evidence 13
1.6.3 Other sources of information and evidence 14
1.7 EBM in human medicine 14
1.8 EBM in veterinary medicine 15
1.9 Are we already practising EBVM? 16
1.10 EBVM case studies 16
1.10.1 Small animals: megavoltage radiotherapy of nasal tumours in dogs 16

1.10.2 Farm animals: restocking after foot and mouth disease *17*
1.10.3 Horses: efficiency of prednisolone for the treatment of heaves (COPD) *18*
1.11 How this book is organised 19
1.11.1 The aims and objectives of this book *19*
1.11.2 Outline of the structure of this book *19*
References and further reading 20
Review questions 22

2 Turning Information Needs into Questions **23**
2.1 Introduction 24
2.2 Refining clinical questions so that evidence can be found 24
2.2.1 Is this a good treatment for a disease? *24*
2.2.2 How good is a test? *24*
2.3 Four main elements of a well-formed clinical question 25
2.3.1 Patient or problem *25*
2.3.2 The diagnostic or therapeutic intervention, prognostic factor or exposure *25*
2.3.3 Comparison of interventions (if appropriate or required) *25*
2.3.4 The outcome *26*
2.4 Categorising the type of question being asked 26
2.5 Prioritising the questions 26
2.6 Checklist of information needs 26
2.6.1 Epidemiological risk factors *27*
2.6.2 Diagnostic process *27*
2.6.3 Treatment *28*
2.6.4 Harm/aetiology *29*
2.6.5 Prognosis *29*
2.6.6 Control (risk reduction) and prevention (risk avoidance) *30*
2.7 Potential pitfalls in constructing questions 30
2.7.1 Complexity of the questions *30*
2.7.2 The need for sufficient background knowledge *31*
2.7.3 More questions than time *31*
2.8 Realistic targets for veterinary practice 31
2.9 Evidence of quality control 31
Further reading 32
Review questions 33

3 Sources of Information **34**
3.1 Introduction 35
3.2 Background and foreground knowledge 35
3.3 Hierarchy of evidence 35

3.4 Important traditional information resources 37
3.4.1 Journals 37
3.4.2 Textbooks and other review type publications 39
3.4.3 Personal experience and background knowledge 39
3.4.4 Colleagues 40
3.4.5 Practice records 40
3.5 The Internet 40
3.6 Veterinary information resources on the Internet 42
3.6.1 CABdirect 42
3.6.2 Consultant 43
3.6.3 Inno-vet 43
3.6.4 International Veterinary Information Service 43
3.6.5 Medline/Pubmed 44
3.6.6 The Merck Veterinary Manual 48
3.6.7 Montreal Veterinary School 48
3.6.8 NetVet and the Electronic Zoo 49
3.6.9 RCVS and RCVS library 50
3.6.10 VetGate 50
3.6.11 VIN 50
3.6.12 Wildlife Information Network 51
3.7 Other computer-based information resources 51
3.7.1 BSAVA 52
3.7.2 CLIVE 52
3.7.3 Lifelearn 52
3.7.4 Vetstream 52
3.8 Critically appraised topics 53
Further reading 53
Review questions 54

4 Searching for Evidence 55
4.1 Introduction 56
4.2 RCVS library 56
4.3 Other online book catalogues 56
4.4 Consultant 57
4.5 Searching strategies: simple Boolean logic 57
4.6 Using Pubmed 58
4.7 Sensitivity and specificity 60
4.8 Special veterinary considerations 60
4.9 Searching for the answers to questions about therapy 61
4.10 Searching for the answers to questions about diagnosis 62
4.11 Searching for the answers to questions about aetiology 62
4.12 Searching for the answers to questions about prognosis 62
4.13 Using the 'Clinical Queries' option in Pubmed 63
4.14 Depth of the veterinary scientific literature 63
4.15 Developing searching skills 65

References and websites 65
Review questions 66

5 Research Studies 67
5.1 Hierarchy of evidence and experimental design 68
5.2 Guide to research methods 69
5.3 Literature reviews 69
5.3.1 Systematic reviews 70
5.3.2 Meta-analyses 70
5.4 Experimental studies 71
5.4.1 Randomised controlled trials 71
5.4.2 Cross-over designs 73
5.5 Observational studies 73
5.5.1 Cohort studies 74
5.5.2 Cross-sectional survey 75
5.5.3 Case–control studies 76
5.6 Diagnostic tests and screening tests 78
5.7 Poorly controlled or uncontrolled trials 78
5.7.1 Comparisons between groups at different times 78
5.7.2 Comparisons between different places 78
5.7.3 n *= 1 trials (the 'treat and see' method) 79*
5.7.4 Uncontrolled trials (before and after trials) 79
5.7.5 Non-random allocation trials 79
5.8 Descriptive studies 79
5.8.1 Surveys 79
5.8.2 Case series and case reports 80
Further reading 81
Review questions 82

6 Appraising the Evidence 84
6.1 Some introductory concepts 85
6.1.1 The importance of statistics 85
6.1.2 Likelihood: probability and odds 86
6.1.3 Risk and uncertainty 87
6.2 Appraising articles on veterinary therapy 88
6.2.1 Is the study valid? 88
6.2.2 Are the results important? 90
6.2.3 Quantifying the risk of benefit or harm 90
6.2.4 Confidence intervals (CIs) 92
6.2.5 Making a decision about therapy 93
6.3 Appraising articles on veterinary diagnosis 93
6.3.1 Is the study valid? 94
6.3.2 Are the results important? 95
6.3.3 SpPin and SnNout 98
6.3.4 Making a decision about a diagnostic test 98

6.4 Appraising articles on harm or aetiology 98
6.4.1 Is the study valid? 100
6.4.2 Are the results important? 101
6.4.3 Statistical analysis 102
6.5 Appraising studies on prognosis 102
6.5.1 Is the study valid? 103
6.5.2 Are the results important? 104
References and further reading 104
Review questions 105
Solution to the probability example used in Section 1 106

7 Diagnosis 107
7.1 Introduction 108
7.2 Definitions 108
7.2.1 Types of diagnosis 109
7.3 The clinical examination: evidence for the presence of disease 110
7.4 Hypothetico-deductive reasoning 111
7.5 The diagnostic process 112
7.6 Recall and ranking 114
7.6.1 Pattern matching 114
7.6.2 Probabilities 114
7.6.3 Pathophysiological reasoning (functional reasoning) 115
7.7 Which method of pattern recognition is used? 116
7.8 Clinical reasoning strategies used in hypothetico-deductive reasoning 116
7.8.1 The properties of clinical signs 116
7.8.2 Logical exclusion of a disease 117
7.8.3 Inductive and deductive reasoning 117
7.8.4 Abstraction/aggregation 117
7.8.5 Prevalence 118
7.9 Errors in hypothetico-deductive reasoning 118
7.10 Logic, sets, Venn diagrams, Boolean algebra 119
7.10.1 Clinical sign sensitivities 120
7.10.2 Disease subsets 120
7.10.3 Venn diagrams and Boolean algebra 120
7.11 Clinical staging of metritis in cattle 122
References and further reading 122
Review Questions 123

8 Clinical Diagnostic Decision Support Systems (CDDSSs) 125
8.1 Introduction 126
8.1.1 Definition 126
8.1.2 Questions you should ask 127

8.2 Understanding the methodology used by CDDSSs 127
8.2.1 Logic 128
8.2.2 List matching 129
8.2.3 Probabilities (Bayes' rule) 129
8.2.4 Knowledge-based systems incorporating symbolic reasoning (syntactical systems) 130
8.2.5 Bayesian belief networks 131
8.2.6 Neural networks 131
8.3 Sources of uncertainty or inaccuracies 131
8.4 Evaluation of the performance of CDDSSs 132
8.4.1 Which is the best method to measure the performance of a CDDSS? 132
8.4.2 Alternative desirable indicators of performance using accuracy 133
8.5 Veterinary diagnostic decision support systems 133
8.5.1 A decision support algorithm for individual cow infertility 133
8.5.2 Consultant 134
8.5.3 Vetstream Canis 138
8.5.4 PROVIDES (Problem Orientated Veterinary Information and Decision System) 138
8.5.5 Bovid 141
8.5.6 EqWise 145
8.5.7 Cattle Disease Diagnostic System (CaDDiS) 146
8.5.8 Application of probability techniques to the objective interpretation of veterinary clinical biochemical data 147
8.6 Sources of information of the CDDSSs described in this chapter 149
Further reading 151
Review questions 152

9 Decision Analysis, Models and Economics as Evidence 154
9.1 Introduction 155
9.2 Decision analysis 155
9.2.1 Methods for clinical decision making 155
9.2.2 Situations in which decision analysis may be helpful 156
9.2.3 The five steps in decision analysis 156
9.2.4 Disadvantages of decision analysis 157
9.3 Decision trees 157
9.3.1 Utilities 158
9.3.2 Solving the decision tree 158
9.3.3 Sensitivity analysis 158
9.3.4 Missing options 158

9.3.5 Helping owners decide *159*
9.3.6 Obtaining utility values from clients and owners *160*
9.3.7 Decision analysis tree for therapeutic decisions *161*
9.3.8 Decision analysis tree for economic decisions *161*
9.3.9 Decision analysis tree of diagnostic tests *163*
9.3.10 Pay-off tables *166*
9.3.11 User checklist for clinical decision analysis *169*
9.4 Testing and treating thresholds 169
9.4.1 General properties of testing and treating thresholds *170*
9.5 Modelling 171
9.5.1 Modelling herd infection dynamics *172*
9.5.2 Modelling and the control of foot and mouth disease *174*
9.5.3 Modelling Staphylococcus aureus *infection in a herd* *175*
9.5.4 User guide to models *175*
9.6 Economic analysis 176
9.6.1 Partial budgets and cost–benefit analysis *176*
9.6.2 User guide to economic analysis *178*
9.7 Medline search functions 178
References and further reading 178
Review questions 180

10 EBVM: Education and Future Needs **182**
10.1 EBM in medical education 183
10.2 Resources for the practice of EBM 183
10.2.1 Critically appraised topics (CATs) *183*
10.2.2 High quality systematic reviews *183*
10.2.3 The Cochrane Library *184*
10.2.4 Secondary journals (e.g. EBM) *185*
10.3 EBM in veterinary education 185
10.3.1 Evidence-based veterinary toolkit *185*
10.3.2 Finding out what is in the literature and what is not in the literature *185*
10.4 What resources do we need for the practice of EBVM? 185
10.5 Clinical (EBVM) audits in veterinary practice 186
10.5.1 What is a clinical audit? *186*
10.5.2 Why do we need a clinical audit? *186*
10.5.3 What has a clinical audit got to do with EBVM? *186*
10.5.4 How do we carry out an EBVM audit? *186*
10.5.5 Clinical audits and the future *187*
10.6 Other future developments 187
References and further reading 188

Glossary of Terms Used in EBVM 190

Bibliography 201

Answers to Review Questions 204

Index 206

PREFACE

Evidence-based medicine has been defined as 'the conscientious, explicit and judicious use of current best evidence in making decisions about the individual patients'. This means integrating individual clinical expertise with the best available clinical evidence from systematic research (Sackett *et al*. 2000). In veterinary medicine a broader, simpler definition may be appropriate, 'Evidence-based veterinary medicine is the use of current best evidence in making clinical decisions'.

This book is for veterinary surgeons at any stage of their training or career who want to learn about evidence-based veterinary medicine (EBVM), but it has been written particularly for non-academic practitioners. It is an attempt to help veterinary surgeons practise EBVM and improve the quality of care for animal patients and provide informed choices for owners. This may take the form of knowing the specificity and sensitivity of a diagnostic test, understanding your own clinical reasoning, interpreting a diagnostic decision support system or understanding what an article about therapy/harm/prognosis is telling you. The practice of EBVM should form part of lifelong, self-directed learning without which you may rapidly become dangerously out of date.

EBVM may be described as 'Just in time learning' (as opposed to 'Just in case learning'), 'Science into practice' or 'From publication to patient'. Whatever jargon is used, it is now time to accept that there is a range of skills that are required to apply best practice to our patients that we may not have. These skills include computer skills, a knowledge of experimental design, the ability to ask questions and transform information needs into questions to which the answer may be found in the literature, and an ability to understand and critically appraise the evidence being presented. We need to have an EBVM toolkit in our armoury of professional skills.

This book aims to explain what EBVM is, and how it can be applied to veterinary practice.

By reading this book you should achieve the following objectives:

- Know how to transform information needs into a series of clinical questions that can be answered
- Know how to search for best available external evidence
- Know how to critically appraise the evidence for its validity and importance
- Know how to apply it in clinical practice
- Understand the process of diagnosis and clinical diagnostic decision support systems.

The authors hope you find the book both useful and interesting.

Peter D. Cockcroft
Mark A. Holmes

Reference

Sackett, D.L., Straus, S.E., Richardson, S.W. and Rosenberg, W. (2000) *Evidence-Based Medicine: How to Practice and Teach EBM*. Churchill Livingstone, Edinburgh.

Acknowledgements

The authors would like to thank Antonia Seymour and Lindsie Court of Blackwell Publishing for their guidance and support and Dr Cerian Webb for her advice on modelling in chapter 9. Mark Holmes would also like to thank the Leverhulme Trust for his Leverhulme Study Abroad Fellowship during which the book was written.

1

INTRODUCTION

'Progress in the field of evidence-based veterinary medicine (EBVM) will become a bench mark of our professional progress in the twenty-first century' (Keene 2000)

1.1 Who is this book for?
1.2 Who isn't this book for?
1.3 What do we mean by EBVM? A brief description
1.4 Comparison of the traditional methods and EBVM
1.5 Why should we practise EBVM?
Because we can
Because our clients can too
We need the information
Time for learning, a diminishing resource faced with expanding demands
Increasing the speed of adopting the results of science
To better direct clinical research
Ethical aspects of proof
Ethical conduct in the absence of scientific evidence
A return to science
Are we ready to ask questions about our own performance?
1.6 A more detailed description of EBVM
The process
The need for evidence
Other sources of information and evidence
1.7 EBM in human medicine
1.8 EBM in veterinary medicine
1.9 Are we already practising EBVM?
1.10 EBVM case studies
Small animals: megavoltage radiotherapy of nasal tumours in dogs
Farm animals: restocking after foot and mouth disease
Horses: efficiency of prednisolone for the treatment of heaves (COPD)
1.11 How this book is organised
The aims and objectives of this book
Outline of the structure of this book
References and further reading
Review questions

1.1 Who is this book for?

This book has been written for veterinary surgeons in non-academic, non-referral practices. A typical veterinary surgeon in such a practice is highly competent, but has to work hard to balance the needs of their business, their family, and their vocation. Our typical veterinary surgeon undertakes formal continuing professional development (CPD) in the form of attendance at courses, meetings and conferences. They purchase the latest editions of textbooks and subscribe to several journals. Although they have little time for reading they try to keep up to date by consulting their books and course notes when faced with unusual cases, and they read articles from the journals. The articles they read are mainly review articles with titles that often include phrases such as 'advances in', 'updates on', 'new techniques in', and 'a new approach to'. These veterinary surgeons know that there is a massive base of scientific work that underpins the work that they do and they rely on the 'experts' who write the books, lecture at meetings, and teach on courses to analyse and appraise this body of scientific work before it is passed into the realm of current best practice.

The benefits that will accrue from the implementation of EBVM include improvements in their levels of knowledge, the focus of that knowledge, and greater satisfaction in their practice of veterinary medicine. Instead of routinely reviewing the contents of dozens of journals for interesting articles, EBVM suggests you target your reading to issues related to specific patient problems. EBVM converts the abstract exercise of reading and appraising the literature into the pragmatic process of using the literature to benefit individual patients while simultaneously expanding the clinician's knowledge base. Developing clinical questions and then searching current databases may be a more productive way of keeping your knowledge base current and appropriate to your patients' needs.

1.2 Who isn't this book for?

This book is not really intended for the academics and specialists who, knowing a little about it already, may regard EBVM with a weary resignation. It is unlikely that their adoption of EBVM would affect the way they practise. They would, quite rightly, claim to have practised EBVM before it became a trendy repackaging of clinical epidemiology. They will be practising to a very high standard, armed with a detailed knowledge of the current literature in their field. They are luckier than more broadly-based practitioners because as specialists, they don't have quite so much literature to read, and with their higher background knowledge they find it easier to understand and apply it to their work. At a subliminal level they might feel a little threatened by it. They may just dismiss the notion that general veterinary practitioners will ever have the time, skills or inclination to use the primary scientific literature. They may also point out that

while the medical profession can call upon a mass of scientific literature covering every clinical situation, the veterinary literature is patchy in its coverage of even common diseases.

Although this book is not intended for the academics and specialists, the authors hope that they will recognise both the feasibility of the practice of EBVM and the advantages to be gained from it in non-academic practice.

1.3 What do we mean by EBVM? A brief description

The widely quoted definition of evidence-based medicine is that 'Evidence-based medicine is the conscientious, explicit and judicious use of current best evidence in making decisions about the care of individual patients'. This means integrating individual clinical expertise and the best available external clinical evidence from systematic research (Sackett *et al.* 2000).

This succinct, and some would say obvious, definition of what we all try to do anyway, belies the more profound philosophy behind EBVM. At its heart is the confidence in the scientific methodology that has developed over the centuries to enable us to distinguish what is likely to be true from what is likely to be false (or unproven). The evidence upon which we base our faith in our clinical decisions is derived from the scientific literature. Practitioners of EBVM develop the skills to find and appraise the literature pertinent to the cases we see, and apply this evidence to the clinical decisions we make.

If this was a book for human doctors we might stop there, but as veterinary surgeons we will frequently find ourselves in situations where there is no primary scientific evidence on which to base our decisions. We will have evidence in the form of expert opinion, case reports, personal experience and other non-literature based sources which should also be collated, assessed, and ranked in order to arrive at a decision.

The most important word in the definition of EBM is probably the word 'explicit'. When a practitioner of EBVM is asked how they chose one clinical option over another, they will be able to explain how and why the decision was made, having pursued an explicit and methodical process.

Finally, in this brief description, it should be said that EBVM is not about pursuing dogma. EBVM is not a home for evangelising zealots. EBVM is another facet of the constantly changing face of veterinary medicine. In general practice no two situations are ever identical, we are constantly forced to compromise, and juggle competing needs. At the end of each day, we examine our consciences to assess our performance. EBVM provides one yardstick for us to measure up to, whoever we believe we are accountable to.

1.4 Comparison of the traditional methods and EBVM

Rapid advances in knowledge constantly challenge our ability to provide the best and most current clinical information for patients. When faced by uncertainty as to the best and most current approach to a clinical problem we can choose from several options:

- We can rely on traditional tried and true protocols and resort to established habits to justify our decisions and give us confidence to proceed down a particular path and diagnosis. These may include: relying on our knowledge of pathophysiology, remembering unsystematic clinical observations of a previous case, tossing a coin to decide between two competing options, intelligent guesswork, doing nothing to avoid harm, remembering what you were taught 10 years ago (if you can), checking your dusty undergraduate notes, asking colleagues, referring to textbooks, browsing journals and doing a database search with an unstructured appraisal
- we can proceed on the basis of our personal experiences or clinical intuition
- we can seek the advice of an expert in the field
- we can rely on scientific EBVM.

The traditional approach suggests that:

- clinical experience is a valid way of gaining an understanding about diagnosis, prognosis and treatment
- pathophysiological rationale is a valid way of guiding treatments
- common sense and classical medical training are the only qualities needed to evaluate medical literature.

The EBVM approach suggests:

- personal experience may be misleading
- randomised studies are required to validate results because predictions based upon physiology may be wrong
- reading literature requires more than common sense to evaluate the evidence.

1.5 Why should we practise EBVM?

1.5.1 Because we can

One of the reasons that EBM has come of age is because of information technology. We no longer have to keep a card index of interesting papers and have access to veterinary school libraries in order to search the literature. With access to the Internet we can search through millions of papers in a matter of seconds. Having located a paper of interest we can often obtain a copy within a minute or two also via the Internet. Access is virtually free, and geographical distance is no

issue. The future of our profession is in our new graduates who, almost without exception, now view the Internet as an everyday source of information, be it the programme at the local cinema, or the latest news from the State Veterinary Service.

Around 89% of veterinary practices in the UK are computerized. More than 50% of the practices have access to the Internet (Veterinary Marketing Association 2001). Vetstream is a commercially available information resource for veterinary surgeons. A survey of Vetstream users in 2001 (64 responders from 874 UK only subscribers (7.3%)) revealed that 82% of responding subscribers had access to the internet. The frequencies with which these subscribers used the internet were: rarely (23%), weekly (23%), once a day (29%) and several times a day (25%).

The use of Vetstream information programs by function in the last month prior to the survey is shown below. Selecting treatments and diagnosis were the functions most used.

Function used in the last month	%
Selecting treatments	81
Diagnosing	78
Reviewing surgical techniques	72
Continuing professional development	63
Staff training	46

1.5.2 Because our clients can too

Almost all the tools that enable us to locate the evidence we need are available to our clients too (and their lawyers). When we make clinical decisions that are questioned by clients following poor outcomes, we need to be able to account for our decisions. There will always be enormous scope, and need for clinical judgement, where possible backed up by the best scientific evidence. Effective communication of the evidence to clients helps them to make informed decisions and avoid unreal expectations.

1.5.3 We need the information

Information needed to solve a problem falls into three categories:

- information that is needed and is known
- information that is needed but is not known
- information needs that are not recognised.

With the volume of new information growing year on year, it is becoming impossible to keep up to date with all developments. It is unrealistic to expect veterinary surgeons to remember everything they need in order to practise since

only the most commonly used information is readily available from memory. There is a need to identify information needs for a specific case and find the best evidence rather than try to retain a rudimentary knowledge. This need places the emphasis on how to look for information and evaluate it rather than trying to consume all the new developments, which is an impossible task. The growth in information is not simple addition to existing knowledge. Veterinary surgeons must identify and replace outdated and obsolete knowledge. Specialisation and information technology can assist this process but greater focus and selectivity in the knowledge we need to know is still required.

Decisions are made about diagnosis, prognosis, treatment and control of disease, and animal management. Veterinary surgeons use information to improve the accuracy of their decisions. Decision-making is based on their personal experience (internal experience) and other sources of experience (external experience), which may include the veterinary literature. The abilities to find the additional information and judge the quality of the information are essential skills (Radostits *et al*. 2000).

Usefulness of information sources commonly used by doctors is summarised in table 1.1 (Smith 1996).

A paper by Shaughnessy *et al*. (1994) put forward a formula for the usefulness of information:

$$\text{Usefulness of medical information} = \frac{\text{relevance} \times \text{validity}}{\text{work to access}}$$

- the relevance of any information is based on the frequency of your exposure to the problem and the type of evidence being presented
- the validity is the likelihood of the information being true
- the work to access the information is the time and effort that must be spent to extract and analyse for the strength of evidence it provides.

The ideal information source would be directly relevant, contain valid information, and be accessed with the minimum of effort.

A table of information sources for veterinary surgeons would not differ significantly from table 1.1. The central role of the veterinary surgeon is to meet the demands of patients, using the best knowledge accumulated over the last 5000 years. The information we hold in our memory may be out of date and wrong. Information sources vary depending on the type of information required. Patients' histories may be derived from owners, patient records, and laboratory data; disease prevalence data may come from local surveys or practice records; medical knowledge may come from textbooks, journals and electronic databases. A major challenge is to match the medical knowledge to the patient problem. In a survey of doctors, lack of time, cost, poor organisation, non-availability of sources, and a glut of sources of differing reliability were seen as barriers to finding information (Smith 1996). This survey found that:

Table 1.1 Sources of information used by human doctors.

Information source	Relevance	Validity	Work to obtain information	Usefulness
Future				
Evidence-based regularly updated electronic textbook	High	High	Low	High
Systematic journal review	High	High	Low	High
Portable summary of systematic reviews	High	High	Low	High
Internet online reviews	High	High	Low	High
Now				
Drug reference book	High	Moderate	Low	High or moderate
Dedicated evidence-based journals	Moderate	High	Low	High or moderate
Colleagues	High	Moderate	Low	High or moderate
Standard textbook	High	Low	Low	Moderate
Standard journal review	High	Moderate	Low	Moderate
Collections of systematic reviews	Moderate but increasing	High	High but should fall	Moderate
Free medical newspapers	High	Low	Low	Moderate
Continuing medical education lectures	Moderate	Moderate	Low	Moderate
Continuing medical education small groups	High	Moderate	Moderate	Moderate
Consensus statements/reports	Moderate	Moderate	Low	Moderate
Clinical guidelines/protocols	Moderate	Moderate	Low	Moderate
Online searching	Moderate	High	High	Moderate
Journal articles	Low	High	High	Low
Drug advertising	Moderate	Low	Low	Low
Drug company representatives	High	Low	Low	Low
Mass media	Low	Low	Low	Low
Internet now	Low	Low	High	Low

- information need arises regularly during consultations
- information need may go unrecognised
- most information needs go unanswered
- many questions arise about treatments and drugs