Web based information on clinical toxicology for the United Kingdom: uptake and utilization of TOXBASE in 2000

D. Nicholas Bateman, Alison M. Good, Catherine A. Kelly & William J. Laing

Scottish Poisons Information Bureau (NPIS Edinburgh), Royal Infirmary of Edinburgh, Lauriston Place, Edinburgh EH3 9YW

Aims To examine the use and uptake of TOXBASE, an Internet database for point of care provision of poisons information in the United Kingdom during its first calendar year of web-based access.

Methods Interrogation of the database software to examine: use by different types of user and geographical origin; profile of ingredient and product access; time of access to the system; profile of access to other parts of the database.

Results Registered users of the system increased in the first full year of operation (1224 new users) and usage of the system increased to 111 410 sessions with 190 223 product monograph accesses in 2000. Major users were hospitals, in particular accident and emergency departments. NHS Direct, a public access information service staffed by nurses, also made increasing use of the system. Usage per head of population was highest in Northern Ireland and Scotland, and least in southern England. Ingredients accessed most frequently were similar in all four countries of the UK. Times of use of the system reflect clinical activity, with hospitals making many accesses during night-time hours. The most popular parts of the database other than poisons information were those dealing with childhood poisoning, information on decontamination procedures, teratology information and slang terms for drugs of abuse.

Conclusions This Internet system has been widely used in its first full year of operation. The provision of clinically relevant, up to date, information at the point of delivery of patient care is now possible using this approach. It has wide implications for the provision of other types of therapeutic information in clinical areas. Web-based technology represents an opportunity for clinical pharmacologists to provide therapeutic information for clinical colleagues at the bedside.

Keywords: clinical toxicology, internet databases, poisons information

Introduction

Provision of information on therapeutics for front-line clinical staff is an important challenge for clinical pharmacologists. The development of web-based technologies makes this medium a potential option for providing information at the point of care. Developments in primary care have been reported [1] but the challenge is in the acute care of patients in the secondary care setting.

Since the 1960s poisons information centres have traditionally provided clinical staff with access via the

telephone. They have used a variety of materials in support of information provision, including books, reviews, original articles and locally produced, commercial or governmental databases. The latter are either held on CD Rom or, increasingly, accessible from Poisons Centres via the Internet [2]. Poisons information has previously been transmitted to the enquirer by both phone and fax in the acute situation.

Within the United Kingdom a computer-based information system, TOXBASE, was developed for information delivery along phone lines in the 1980s, and used Viewdata technology as its platform support. This system has been previously reported [3], but was not widely adopted outside Scotland and Northern Ireland. In practice, because of its platform, it was not easy to edit the database. By the late 1990s the system was therefore dated and slow by modern standards.

Correspondence: Dr D. N. Bateman, Scottish Poisons Information Bureau (NPIS Edinburgh), Royal Infirmary of Edinburgh, Lauriston Place, Edinburgh EH3 9YW. E-mail: Nick.Bateman@luht.scot.nhs.uk

Received 20 July 2001, accepted 6 December 2001.

Increasing demands for poisons information by telephone led the Directors of the UK National Poisons Information Service (NPIS) and the UK Departments of Health to evaluate alternative methods of poisons information delivery to UK hospitals and primary care physicians. It was agreed that the TOXBASE system would form a key element in changes proposed within the poisons information network, and that this would be placed on an Internet platform [4]. We have previously reported on the introduction of the system in the United Kingdom over the first few months of operation [5]. We now report on the first calendar year's activity, discuss the information available from the use of the system, and the implications for future provision of material via the Internet on therapeutics.

The database

TOXBASE (www.spib.axl.co.uk) is provided to registered users within the National Health Service free of charge. It is searchable by keyword (from 2001 sound search as well) and includes information on approximately 14 000 products. The database was originally constructed in 1981 [3] and has been maintained since then by the staff of the Edinburgh Centre of the NPIS with input from the other NPIS Centres. In addition to poison information it also contains a series of monographs on subjects of toxicological relevance, including childhood poisoning, deliberate chemical release, decontamination procedures, eye decontamination, teratology, slang names for drugs of abuse and non toxic household products. In addition health warnings of a toxicological nature can be posted on the database within 24 h of their receipt.

Outputs include structured on-screen clinical information and treatment advice, printable fact-sheets on individual poisons, together with the aforementioned monographs. Purpose-written user response facilities within the system include those on poisoning with new drugs, adverse reaction reports for veterinary medicines, and follow up of drugs and poisons of interest to the NPIS.

Methods

The software within the system's server individually documents inquiries to the database. The data collected includes the origin of the call, the time of the call, the parts of the database accessed, and individual product entries examined.

Information on the TOXBASE database can be categorized into the number of times the database is accessed (number of *sessions*), the individual *products* accessed, for example pharmaceuticals or household products, and the number of individual *ingredients* (or in the case of household products ingredient type) referred to. In addition accesses to the specific monographs on the database have also been examined.

Different user categories include: NPIS centres, hospital departments of various type, primary care physicians, and NHS Direct centres. These tend to access different product groups. For example NHS Direct centres are staffed by trained nurses and provide information directly to the public on health issues. We have therefore analysed usage of the database by user type, concentrating particularly on the products and parts of the database accessed. We have also examined the timing of database use by different groups. Finally we have examined use of the database by hospital accident and emergency departments in the four countries that make up the UK.

We have used population estimates provided by the UK Departments of Health to provide a denominator against which to compare use of the database for the geographical regions we have compared.

Results

In total 1224 new users were registered (Figure 1) during the year 2000. For comparison only 20 new registered users were added to the Viewdata system in 1998.

The total numbers of users registered at the end of 2000 and their locations are shown in a Table 1. This also includes details of the numbers of sessions and product

Figure 1 Registered users at the end of each month.

Table 1 Total registrations at 31 December 2000 and usage during 2000.

	Total users	Total user sessions	Total products accessed	Products/user
A & E departments	296	83 556	129 013	436
Other hospital departments	815	9364	12 371	15
Poisons centres	17	8545	33 294	1958
GPs	673	1711	1871	3
NHS Direct	24	7408	12 576	524
Others	175	826	1098	6
Total/average	2000	111 410	190 223	95

Table 2 Usage of TOXBASE by region in England and Scotland.

Country	Health Board/Regional Office	Sessions	Sessions/ 100 000 population
England	Eastern	6401	118
	London	2693	37
	North-west	9730	148
	Northern and Yorkshire	22 123	349
	South and West	8210	124
	South-east	5763	66
	Trent	7136	139
	West Midlands	9792	184
Total/average		71 848	144
Scotland	Argyll & Clyde	2352	551
	Ayrshire & Arran	1080	288
	Borders	400	376
	Dumfries & Galloway	692	470
	Fife	1435	411
	Forth Valley	1145	415
	Grampian	2711	516
	Greater Glasgow	2665	292
	Highland	746	358
	Lanarkshire	1997	356
	Lothian	1150	149
	Orkney	95	486
	Shetland	0	—
	Tayside	1624	417
	Western Isles	50	179
Northern Ireland		18 142	354
Wales		13 725	811
		6781	230

accesses in 2000. Table 2 shows the uptake of the database by different health regions in England and health boards in Scotland. Use of the database shows geographical variation, with least use in the south of England.

To illustrate usage of the database we have analysed the most frequent inquiries in 2000, and for comparison include data collected from the previous Viewdata system

for the previous 5 years in Table 3. This shows clearly that inquiries about products containing paracetamol have remained the most frequent for the past 6 years. For paracetamol the numbers of inquiries in 2000 are more than twice as high as those for the previous year. Other changes are likely to reflect changes in the numbers of patients presenting with individual intoxications, thus inquiries about SSRI antidepressants are increasing whereas those for tricyclic antidepressants are decreasing.

Times of access to the database vary with type of user and this is illustrated in Figure 2. NHS Direct inquiries, which arise from members of the public, are least frequent during night time, and those from general practice are highest in surgery hours. Hospital inquiries are least frequent between 5:00 am and 9:00 am but remain relatively constant for the rest of the day.

Access from different user types is to different product groups and this is illustrated in Table 4 in which we show the most frequent inquiries from hospital accident and emergency departments, NHS Direct users and GPs for comparison. NHS Direct inquiries are more typical of exposures seen in the home in children, thus reflecting the different user base. Those from hospitals are more pharmaceutically based.

Table 5 shows the top ingredients accessed by A & E departments in the four countries that make up the UK. There are similarities between countries, with paracetamol, ibuprofen, codeine and aspirin common to all. In England inquiries about zopiclone exceeded diazepam. Thioridazine was only seen in the top 10 in Northern Ireland and Scotland.

Table 6 lists the information other than specific products monographs that is accessed most frequently. Paediatric, eye and teratology inquiries were the most common.

Discussion

The provision of therapeutic information via modem technology is feasible. Outstanding questions include its accessibility to busy clinical staff, its usefulness in practice and its accuracy. The information collected on its use is an indication of clinical activity, but does not represent all poisoning cases, or indicate the reason for the interaction with the system, which could be educational in some instances. The increasing use of the system, and pattern of enquiries do, however, illustrate the extensive acceptability of this approach to information provision, which appears to be of practical use and valued by its users (NPIS feedback). Further developments in operating software within hospital clinical information systems may allow an audit trial to be developed that will provide more information on the use of TOXBASE. Such audit systems already exist or are planned within NHS Direct systems.

Table 3 Top ingredients accessed on TOXBASE in 1996–2000.

Ingredient name	Position in year (total number of products accessed)					Number of accesses in 2000 (% of total)
	1996 (67 274)	1997 (81 358*)	1998 (71 605*)	1999 (123 579*)	2000 (190 223)	
Paracetamol	1	1	1	1	1	21 668 (11.4)
Detergents/surfactants (not cationic)	11	14	13	5	2	5276 (2.8)
Salicylate	2	2	2	2	3	5194 (2.7)
Ibuprofen	5	4	4	4	4	5057 (2.7)
Codeine	3	3	3	3	5	4690 (2.5)
Zopiclone	10	7	6	7	6	3804 (2.0)
Diazepam	8	6	5	6	7	3693 (1.9)
Fluoxetine	9	11	9	11	8	3198 (1.7)
Caffeine	6	8	8	9	9	3023 (1.6)
Paroxetine	14	10	12	9	10	2997 (1.6)
Thioridazine	15	12	11	12	11	2912 (1.5)
Ethanol	23	22	25	15	12	2800 (1.5)
Petroleum distillates	4	5	7	8	13	2722 (1.4)
Dothiepin	7	9	10	13	14	2710 (1.4)
Sodium hypochlorite	24	18	20	19	15	2604 (1.4)
Ecstasy	18	24	32	22	16	2598 (1.4)
Dextropropoxyphene	17	15	16	17	17	2390 (1.3)
Amitriptyline	16	16	15	14	18	2271 (1.2)
Dihydrocodeine	13	17	17	20	19	2298 (1.2)
Menthol	19	18	21	18	20	2064 (1.1)

*Estimated because 39 days (11%), 9 days (2%) and 91 days (25%) data were lost in 1997, 1998 and 1999, respectively, due to loss of computer statistics on the backup computer. This is not likely to affect rank order of accesses.

The establishment of a database of the size of TOXBASE required a considerable initial outlay of staff time [3]. Approximately 2 years of dedicated staff time was needed initially for the authorship of the Viewdata database. It took 4 man-months to convert that Viewdata system for Internet use. At present over 50 man-hours a week are spent on the database, in maintenance, updating, new product entries, user support and usage analysis. This requires the skills of clinicians, poisons information officers and technical support staff.

The number of registered users of TOXBASE increased by more than 150% in the year 2000. TOXBASE is the primary database of the UK National Poisons Information Service and not surprisingly poisons centre users access the largest number of products per registered user. This group includes the National Poisons Information Centre in Dublin, which became a registered user while discussions were underway to provide TOXBASE to Irish users (available to Irish A & E users from March 2001).

The other high volume users are accident and emergency departments and NHS Direct centres. In Scotland and Northern Ireland almost all of the former have been regular users for some years, and this accounts for the high number of user sessions/100 000 population for these countries. Usage figures for Lothian in Scotland are

lower than might be expected because the Accident and Emergency Department at the region's major teaching hospital, Lothian University Hospitals NHS Trust, uses a local intranet version of TOXBASE for which no statistics can be currently provided. Usage in Northern Ireland is particularly high reflecting local practice. The lower rates in England and Wales reflect the extent of coverage. Highest rates in England are in Northern and Yorkshire, North-west, and in the West Midlands where local NPIS centres have promoted TOXBASE usage.

The use of TOXBASE by NHS Direct centres is expected to increase even further as TOXBASE becomes more closely linked with their decision making software. Further NHS Direct centres, together with walk-in centres, are being established in England and Wales, and the Scottish help-line, NHS 24, will start operation in 2002.

During 2000 our users accessed 6832 of the approximately 14 000 individual products and substances. Some were accessed very many times and the total number of product accesses was 190 223. Many different products contain the same active ingredient, for example Panadol and Calpol both have paracetamol as their active ingredient. Table 3 shows the top 20 ingredients, or, for household products, ingredient types. 32% of TOXBASE

Figure 2 (a) Time of access – hospitals, (b) time of access – NHS direct entries and (c) time of access – GPs.

product inquiries can be addressed by information on the features and treatment of poisoning involving 10 ingredients. 45% of inquiries are addressed by information on 20 ingredients. Thereafter the numbers rise exponentially. This information is used to ensure that information for frequent inquiries is updated and reviewed regularly, but also provides a profile of expected toxicology presentations.

Paracetamol is the most common agent accessed with almost three times as many accesses as the next most common. This is also the most frequent agent ingested in overdose in the UK [6, 7]. Analgesics as a group are well represented amongst frequent inquiries. Enquiries about the benzodiazepine diazepam and related hypnotic zopiclone are also common. Antidepressants occupy seven of the top 20 positions, with SSRIs generally occupying higher places than the older tricyclics. Only one anti-psychotic, thioridazine, and one drug of abuse, ecstasy, are in this top 20 group.

The top ingredients accessed by the A & E departments of the four UK countries (Table 5) are similar, with the top seven ingredients in England, paracetamol, ibuprofen, codeine, aspirin, zopiclone, diazepam and caffeine,

appearing in the top 10 for each of the other countries. Of the remainder all are found in the top 20 for the other countries except for temazepam which is only 29th in Scotland and 31st in Wales.

For the top products (rather than ingredients) accessed by different categories of users (A & E, NHS Direct and GPs) (Table 4) A & E departments make more inquiries regarding drugs (prescription, over the counter and drugs of abuse), while NHS Direct inquiries mainly involve over the counter drugs and household products. The numbers of enquiries from GPs are small and the information is probably skewed by those looking at the database for information or interest.

Of the information other than product monographs that is most commonly accessed, general information on paediatric poisoning is most popular. This is not surprising since almost 40% of telephone enquiries to NPIS centres concern children under the age of 10 years [8]. It would be expected that a similar proportion of TOXBASE enquiries would be about children. Other popular accesses include those about gut and eye decontamination, lists of drug slang terms and information from the National Teratology Information Service, which advises on poisoning in

Table 4 Top products accessed by types of users and percentage of total products accessed for that user type.

<i>Product name</i>	<i>NHS Direct number (%)</i>	<i>Product name</i>	<i>A & E number (%)</i>	<i>Product name</i>	<i>GP number (%)</i>
Paracetamol	535 (4.3)	Paracetamol	9024 (7.0)	Paracetamol	76 (4.6)
Ibuprofen	192 (1.5)	Diazepam	2873 (2.2)	Ecstasy	38 (2.3)
Bleach – liquid	156 (1.2)	Aspirin	2398 (1.9)	Batteries (button)	33 (2.0)
Karvol decongestant capsules	128 (1.0)	Ibuprofen	2342 (1.8)	<i>Vipera benus</i> (adder)	30 (1.8)
Cleaning liquid – household general	127 (1.0)	Zopiclone	2220 (1.7)	Lavatory cleaner (liquid bleach)	24 (1.5)
Holly	122 (1.0)	Ecstasy	1916 (1.5)	Snake-bite unknown type	24 (1.5)
Silica gel	121 (1.0)	Dothiepin	1797 (1.4)	Paraquat	19 (1.2)
Nail lacquer	120 (1.0)	Amitriptyline	1764 (1.4)	Cleaning liquid – household general	17 (1.0)
Vitamin pills	118 (0.9)	Temazepam	1667 (1.3)	Aspirin	13 (0.8)
Lavatory cleaner (liquid bleach)	87 (0.9)	Co-proxamol	1528 (1.2)	Ferrous sulphate	13 (0.8)

Table 5 Top 10 ingredients and number of accesses for A & E departments in the UK countries in 2000.

	<i>England</i>	<i>Northern Ireland</i>	<i>Scotland</i>	<i>Wales</i>
1	Paracetamol (14 415)	Paracetamol (3148)	Paracetamol (2960)	Paracetamol (1102)
2	Ibuprofen (3687)	Codeine (768)	Ibuprofen (698)	Aspirin (319)
3	Codeine (3041)	Diazepam (724)	Codeine (638)	Ibuprofen (236)
4	Aspirin (2957)	Aspirin (450)	Aspirin (622)	Codeine (229)
5	Zopiclone (2856)	Ibuprofen (429)	Diazepam (547)	Ethanol (208)
6	Diazepam (2240)	Thioridazine (370)	Fluoxetine (506)	Caffeine* (192)
7	Fluoxetine (2196)	Temazepam (363)	Paroxetine (476)	Diazepam (178)
8	Paroxetine (2168)	Fluoxetine (363)	Caffeine* (436)	Sodium hypochlorite (154)
9	Caffeine* (2056)	Zopiclone (348)	Zopiclone (434)	Zopiclone (152)
10	Dothiepin (2000)	Caffeine* (325)	Thioridazine (432)	Methylenedioxy methamphetamine (146)

*Caffeine from compound analgesics.

Table 6 Top information sources on TOXBASE.

<i>Information</i>	<i>Number of accesses</i>
Paediatric poisoning	4375
Chemicals splashed or sprayed into the eye	3955
The National Teratology Information Service	3130
Oral activated charcoal	2648
Slang names for drugs list	1639
Slang terms used by addicts	1438
Decontamination procedures	1353
Blood alcohol graph	1317
Problems with TOXBASE	913
Deliberate release of toxic chemicals	864

pregnancy. While these general monographs are not accessed as often as the top ingredients (Table 3, Table 6) they nevertheless had more than 1500 accesses each in the year. Two-way interaction with users by e-mail is also possible, and optimizing use of this facility is the next challenge.

Conclusions

Moving TOXBASE to the Internet has made it more readily accessible to end-users, and increased its use by a variety of different groups of health professionals. The most common poisons accessed have not changed with

increased use. The time of access of different user groups reflects their patient client groups and their working patterns.

TOXBASE provides information at the point of healthcare delivery. Our data demonstrates the wide acceptability and use of the system, and indicates that provision of therapeutic information via modern technology is both feasible and practically useful. Information available to us, as system providers, gives an insight into the profile of clinical toxicological problems facing the different types of health professionals using the system. Web-based systems can be readily updated and carry early warnings on topics of clinical relevance. The challenge for their authors, and clinical pharmacologists as a group, is to maximize the huge educational potential of systems that deliver clinical treatment advice at the bedside.

We wish to acknowledge the help and collaboration of our colleagues in the NPIS without whom this work would not have been possible. The original concept was developed on Viewdata by Dr A. T. Proudfoot and supported by the Scottish Home and Health Department (now Scottish Executive Health Department).

References

- 1 Rogers J, Jain NL, Hayes GM. Evaluation of an implementation of PRODIGY phase two. *Proceedings of the 1999 AMLA Annual Symposium*, AMIA, Bethesda.
- 2 Holohan TW, Humphreys CP, Johnson H, *et al.* Sources of information for acute poisoning in accident and emergency departments in Dublin, Ireland. *J Toxicol Clin Toxicol* 2000; **38**: 29–36.
- 3 Proudfoot AT, Davidson WSM. A viewdata system for poisons information. *Br Med J* 1983; **286**: 1125–1127.
- 4 Information from the National Poisons Information Service. *CMOS Update* 2000; **25**: 3.
- 5 Bateman DN, Good AM, Laing WJ, Kelly CA. TOXBASE. Poisons information on the Internet. *Emerg Med J* 2002; **19**: 31–34.
- 6 Thomas SHL, Bevan L, Bhattacharyya S, *et al.* Presentation of poisoned patients to accident and emergency departments in the North of England. *Hum Exp Toxicol* 1996; **15**: 466–470.
- 7 Hawton K, Townsend E, Deeks J, *et al.* Effects of legislation restricting pack sizes of paracetamol and salicylate on self poisoning in the United Kingdom: before and after study. *Br Med J* 2001; **32**: 1–7.
- 8 NPIS. Edinburgh centre. Annual Report. <http://www.show.scot.nhs.uk/spib>, 2000.