Update on the status of 89 drug information centers in the United States

S since 1974, the International Drug Information Center of the Arnold & Marie Schwartz College of Pharmacy and Health Sciences has published numerous surveys and directories of pharmacist-operated drug information centers (DICs).1-13 These publications provided information regarding the number of DICs in the United States and Puerto Rico and identified trends in various aspects of this area of pharmacy practice. The most recent directory of DICs was compiled in 2003 and listed 86 DICs.13 Three additional DICs were identified shortly after the publication of the directory, bringing the total number of DICs to 89.14

Recently, it has been suggested, based on interviews with drug information specialists, that the number of DICs is decreasing.15 Possible reasons include the widespread availability of Internet resources and personal digital assistants (PDAs), as well as changes in pharmacy practice and education. A search of the biomedical and pharmaceutical science literature did not identify data for the current number of existing DICs in the United States.

The main objective of this study was to determine whether the 89 previously reported DICs13,14 were still in existence. Furthermore, for the existing centers, we examined if changes occurred since 2003 in their primary mission, time devoted to various activities, volume and complexity of questions received, time required to answer a question, staffing, and revenue generation. Finally, we requested the respondents’ opinions...

Jack M. Rosenberg, Pharm.D., Ph.D., is Director, International Drug Information Center, and Professor of Pharmacy Practice and Pharmacology; Sara Schilit, Pharm.D., is Drug Information Specialist, International Drug Information Center, and Adjunct Assistant Professor of Pharmacy Practice; Joseph P. Nathan, M.S., Pharm.D., is Associate Professor of Pharmacy Practice; and Tina Zerilli, Pharm.D., is Assistant Professor of Pharmacy Practice, Arnold & Marie Schwartz College of Pharmacy and Health Sciences, Long Island University (LIU), Brooklyn, NY. Howard McGuire, Ph.D., is Professor of Psychology and Biostatistics, Department of Psychology, Richard L. Conolly College of Liberal Arts and Sciences, LIU.

Address correspondence to Dr. Rosenberg at the International Drug Information Center, Arnold & Marie Schwartz College of Pharmacy and Health Sciences, Long Island University, 75 DeKalb Avenue, Room HS 509, Brooklyn, NY 11201 (jack.rosenberg@liu.edu).

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regarding the need for their DICs in the future.

Methods

In April 2008, we e-mailed an electronic survey to the 89 DICs previously identified as meeting the inclusion criterion used in our series of surveys, which was centers that accept a broad scope of requests on a regular basis from health care professionals, regardless of the location or affiliation of those professionals. Directors of the DICs were e-mailed a cover letter and a link to access the survey instrument electronically via SurveyMonkey (SurveyMonkey.com, Portland, OR). The e-mail addresses were obtained from our published data\textsuperscript{13,14} and verified with an Internet search. The DIC directors for whom an e-mail address was not available were contacted via telephone. Nonresponders to the initial e-mail received a follow-up e-mail two to three weeks later. After the second e-mail, up to five telephone calls were made to nonresponders or their parent organizations (i.e., hospitals or universities) to obtain information about all 89 centers.

The survey instrument consisted of 11 multiple-choice questions. The survey instrument requested information on whether the center was still in existence. For DICs in existence, questions were designed to identify the DIC’s primary mission and whether changes had occurred since 2003. Information was also requested about any changes in the time spent on specified activities by the DIC’s personnel in the previous five years. In addition, the survey collected information on changes over this five-year period in the number of drug information requests received, the number of complex questions received, the average amount of time required to answer a drug information request, the time spent on fee-for-service activities, and the number of salaried drug information personnel involved in the activities of the center. For the purpose of this survey, complex questions were defined as those that required evaluation of the primary literature and critical thinking skills—a definition that has been used previously.\textsuperscript{16} Finally, the survey requested the DIC director’s opinion regarding the need for the DIC in the next five years. An outside expert in the field of drug information reviewed the survey before its distribution. No changes were made to the instrument based on this review.

Descriptive statistics, compiled with SurveyMonkey, were used to analyze the data. Several follow-up analyses were conducted to examine the degree and type of association between sets of responses to survey questions. A Pearson chi-square contingency test for independence was used, using SPSS version 15 (SPSS Inc., Chicago, IL), to determine the relationship between the number of DICs reporting a change in the number of drug information requests received and the number of DICs reporting a change in the time required to answer each question. Similarly, a Pearson chi-square test was used to analyze the relationship between the number of DICs reporting a change in the number of complex questions received and the number of DICs reporting a change in the time required to answer each question. The study received an exempt status from Long Island University’s institutional review board.

Results

Number of DICs. Of the 89 DICs surveyed, 75 (84%) were still in existence, and 14 centers (16%) ceased to exist as organized DICs. One of the inactive centers retained a notice on its website informing of its closure. Another DIC had a recorded message on its previously active telephone line, which stated that services were discontinued. Information regarding the closure of the other 12 centers was obtained from staff members at the parent institutions.

Mission. When asked to identify the primary mission of their DIC, 50 (69%) of 73 respondents to this question indicated that it was the provision of drug information services on a not-for-profit basis, 20 (27%) stated education of health-professions students, and 3 (4%) indicated the provision of drug information services for profit or contract work. Of the 72 centers that responded to the question of whether their primary mission had changed, 3 (4%) reported a change. These 3 centers reported that education of health-professions students is currently their primary mission. One of these centers reported that in 2003, its primary mission was the provision of drug information services on a not-for-profit basis, while another reported that its primary mission was the provision of drug information services for profit or contract work in 2003. The third center reported that it had two main missions in 2003: the provision of drug information services and research. This center added the education of health-professions students as one of its current main missions.

Activities. DICs were asked whether the time spent on a variety of activities had increased, decreased, or remained the same. Sixty-six (88%) of 75 centers responded to this question (Table 1). The most notable changes were increases in the time spent on the following activities: educating health-professions students \((n = 35)\), supporting the institution’s medication safety program \((n = 29)\), and providing information systems (informatics) support \((n = 24)\). When asked whether there was a change in the total amount of time spent answering drug information requests, 22 respondents (33%) reported an increase, 18 (27%) reported a decrease, and 26 (39%) reported no change.
Drug information centers

Survey recipients were asked whether there was a change in the number of drug information requests received by their DIC. Of the 66 respondents, 19 (29%) reported an increase, 28 (42%) reported a decrease, and 19 centers (29%) indicated that the number of drug information requests received had remained the same. When asked whether there was a change in the number of complex drug information requests received, 46 (70%) of 66 respondents reported an increase, 1 (2%) reported a decrease, and 19 (29%) indicated no change. With respect to the change in the average amount of time required to answer a drug information request, 35 (53%) of the 66 respondents reported an increase, 5 (8%) reported a decrease, and 26 (39%) reported no change.

Examination of the relationship between the number of DICs reporting an increase in the number of drug information requests received and the number of centers reporting an increase in the amount of time required to answer each question revealed a significant negative association ($\chi^2(4) = 35.2, p = 0.00001$).

Fee-for-service activities. Forty-seven (71%) of 66 respondents reported no involvement in fee-for-service activities. Of the remaining 19 centers, 11 (58%) reported an increase, 3 (16%) reported a decrease, and 5 (26%) reported no change in the amount of time spent on fee-for-service activities.

Personnel. With respect to the number of salaried drug information personnel involved in DIC activities, 9 (14%) of 66 respondents reported an increase, 9 (14%) reported a decrease, and 48 (73%) reported no change.

Continued need for DIC. Participants were asked for their opinion concerning the need for their organized DIC over the next five years. While 37 (56%) of 66 respondents projected an increase and 2 (3%) projected a decrease in the need for their organized DIC, 27 (41%) predicted no change in the need for their center.

Discussion

For more than three decades, the number of organized DICs in the United States has fluctuated. In 1974, Rosenberg et al. reported the existence of 54 DICs that met a specified definition. The number of centers that met the same definition peaked to 127 in 1986 and decreased to 89 in 2003. The current survey found that of these 89 DICs, 75 (84%) were still in existence. We did not attempt to report the number of DICs in existence in the United States but to examine the fate of the DICs identified by the last survey. A comprehensive survey of DICs in the United States must be conducted to truly assess the current number of DICs.

The reason for the decrease in the number of DICs found in this survey is unknown. However, it may be partially due to the widespread availability of comprehensive computerized drug information databases, the Internet, and PDAs.

Table 1. Changes in the Time Spent on Drug Information Center (DIC) Activities From 2003 ($n = 66$)

<table>
<thead>
<tr>
<th>Activity</th>
<th>Increased</th>
<th>Decreased</th>
<th>Remained the Same</th>
<th>Never Offered by DIC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Answering drug information requests</td>
<td>22 (33)</td>
<td>18 (27)</td>
<td>26 (39)</td>
<td>0</td>
</tr>
<tr>
<td>Conducting pharmacoeconomic evaluations</td>
<td>11 (17)</td>
<td>5 (8)</td>
<td>24 (36)</td>
<td>26 (39)</td>
</tr>
<tr>
<td>Contributing to biomedical literature</td>
<td>13 (20)</td>
<td>5 (8)</td>
<td>40 (61)</td>
<td>8 (12)</td>
</tr>
<tr>
<td>Educating health-professions students</td>
<td>35 (53)</td>
<td>2 (3)</td>
<td>29 (44)</td>
<td>0</td>
</tr>
<tr>
<td>Participating in DUR/MUE activities</td>
<td>17 (26)</td>
<td>4 (6)</td>
<td>31 (47)</td>
<td>14 (21)</td>
</tr>
<tr>
<td>Participating in pharmacy and therapeutics committee activities</td>
<td>19 (29)</td>
<td>4 (6)</td>
<td>31 (47)</td>
<td>12 (18)</td>
</tr>
<tr>
<td>Providing direct patient care at bedside</td>
<td>3 (5)</td>
<td>2 (3)</td>
<td>15 (23)</td>
<td>46 (70)</td>
</tr>
<tr>
<td>Providing information systems (informatics) support</td>
<td>24 (36)</td>
<td>1 (2)</td>
<td>21 (32)</td>
<td>20 (30)</td>
</tr>
<tr>
<td>Providing inservice education</td>
<td>15 (23)</td>
<td>3 (5)</td>
<td>34 (52)</td>
<td>14 (21)</td>
</tr>
<tr>
<td>Providing support for investigational drug programs</td>
<td>8 (12)</td>
<td>3 (5)</td>
<td>19 (29)</td>
<td>36 (55)</td>
</tr>
<tr>
<td>Reporting adverse drug reactions</td>
<td>18 (27)</td>
<td>1 (2)</td>
<td>35 (53)</td>
<td>12 (18)</td>
</tr>
<tr>
<td>Supporting the institution’s medication safety program</td>
<td>29 (44)</td>
<td>0</td>
<td>20 (30)</td>
<td>17 (26)</td>
</tr>
<tr>
<td>Writing newsletters</td>
<td>19 (29)</td>
<td>7 (11)</td>
<td>35 (53)</td>
<td>5 (8)</td>
</tr>
</tbody>
</table>

*DIC = drug information center, MUE = medication-use evaluation.
The use of these electronic media by health care professionals and the lay public may serve as a substitute for contacting DICs for answers to routine drug information questions. In addition, with the entry-level doctor of pharmacy degree, pharmacists are receiving better training to handle drug information requests, as mandated by the Accreditation Council for Pharmacy Education.  
In 2000, a survey designed to determine practicing pharmacists’ use of DICs found that pharmacists with a bachelor of science degree utilized DICs more often than pharmacists with training beyond this degree.  
Although that study did not provide an explanation for this finding, advanced training may have played a role in the decreased use of DICs by pharmacists. Interestingly, this survey found that all DICs are currently involved in educating health-professions students (Table 1). Fifty-three percent of respondents reported an increase in the time spent on this activity, while only 2 respondents (3%) reported a decrease in the time spent on education.  

We could not identify a clear trend in the change in the amount of time DICs devoted to answering drug information requests. However, we did find a significant association between the number of centers reporting a decrease in the number of questions received and the number of centers reporting an increase in the time required to answer drug information questions. Furthermore, a significant association was found between the number of centers reporting an increase in complex questions and the number of centers reporting an increase in the amount of time required to answer each question, indicating that as the number of complex questions increased, the amount of time required to answer each question increased. Thus, although 42% of DICs have been receiving fewer questions, those received require more time to be answered, presumably because they are more complex in nature. This is similar to the findings reported by the University of Tennessee DIC, which noted that compared to a decade earlier, the center experienced a significant decrease in the number of drug information questions received, an increase in the complexity of questions, and an increase in the amount of time required to answer these questions.  
Despite the fact that 42% of DICs reported a decrease in the number of questions received, only 14% of respondents reported a decrease in the number of drug information personnel employed by their DIC. Although the reason for this could not be determined from the design of this study, it may be partly due to the increased complexity and time required to answer drug information questions, as well as the time spent on new or expanded activities within the DICs.  

The majority of respondents (97%) projected that the need for their center will remain the same or increase over the next five years. Although we recognize that this may not accurately reflect the opinion of the parent institution, this consensus among the surveyed drug information specialists appears to represent a more optimistic view of the future of DICs compared with that previously expressed.  

A limitation of this survey was that it was designed to determine the status of the 89 DICs previously identified and may not necessarily reflect an overall national trend in DICs. In addition, a five-year comparison may be insufficient to reflect long-term trends in DICs. Furthermore, this survey relied on the ability of DIC personnel to recall and form comparisons with information from five years prior. Lastly, we could not ensure that participants were employees at their DICs five years earlier.  

Conclusion  
Eighty-four percent of the previously identified DICs were still in existence. The most notable changes in these DICs were increases in the number of centers focusing on the education of health-professions students, the complexity of drug information requests, and the amount of time required to answer each request.  

References  
2. Rosenberg JM, Kirschenbaum H. How pharmacy’s drug information centers are enhancing safe & efficacious therapy. Pharm Times. 1976; 42(Feb):56-64.  
Long-term stability of extemporaneously prepared captopril oral liquids in glass bottles

JORGEN BRUSTUGUN, YVONNE ELISABETH LAO, CHARLOTTE FAGERNÆS,
JORUNN BRÆNDE, AND SOLVEIG KRISTENSEN

Captopril, an angiotensin-converting-enzyme inhibitor, is used for the treatment of several conditions, such as hypertension and heart failure.1 Though most frequently used in the management of circulatory conditions in adults, it may also be used to treat such conditions in infants and children.2,3 When used for long-term treatment in adults, the drug is normally administered as tablets. However, this dosage form is not suitable for infants and small children, and hospital pharmacies must compound liquid preparations of captopril for oral administration for these patients. Captopril, however, is prone to oxidation.4 Several factors, such as pH, drug concentration, content of oxygen, and the presence of metal ions, have been suggested to affect the stability of captopril in solution.5,6 We recently evaluated the influence of formulation properties on the stability of captopril for oral administration.

Purpose. The long-term stability of captopril in extemporaneously prepared oral liquids was studied.

Methods. Captopril solutions of 1 and 5 mg/mL were prepared in sterile water for irrigation with sorbitol, disodium edetate, and sodium benzoate. The samples were stored in 100-mL amber glass bottles with a headspace of air at 22 °C for 12 months. The captopril concentration was determined by high-performance liquid chromatography at 0, 3, 6, 9, and 12 months. The pH of the solutions was also measured, and the physical appearance was recorded. The stability of the 1-mg/mL captopril preparation during 1 month of simulated use when stored at 2–8 °C was tested at the start and the end of the 12-month study period. The microbiological quality of the preparations was tested at 0, 6, and 12 months (1 mg/mL) and 0 and 12 months (5 mg/mL).

Results. Throughout the 12-month study period, the captopril concentration in the oral liquids exceeded 90% of the initial concentration. The lowest concentration (98.5%) was detected in the 5-mg/mL preparation after 3 months of storage. The 1-mg/mL preparation was stable during 1 month of simulated use, both at the start and the end of the 12-month study period. No microbiological growth was observed in any of the samples tested.

Conclusion. Extemporaneously prepared oral liquid formulations of captopril 1 and 5 mg/mL were chemically stable when stored in glass bottles at room temperature for 12 months when stabilized with 0.1 mg/mL disodium edetate at a low pH.

Index terms: Angiotensin-converting-enzyme inhibitors; Captopril; Chromatography, liquid; Compounding; Concentration; Contamination; Edetate disodium; Excipients; Hydrogen ion concentration; Sodium benzoate; Solutions; Sorbitol; Stability; Stabilizers; Storage