Characteristics and temporal trends in patient registries: focus on the life sciences industry, 1981–2012

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ABSTRACT

Purpose 
Patient registries are used to monitor safety, examine real-world effectiveness, and may potentially contribute to comparative effectiveness research. To our knowledge, life sciences industry (LSI)-sponsored registries have not been systematically categorized. This study represents a first step toward understanding such registries over time.

Methods 
Studies described as registries were identified in the ClinicalTrials.gov database. Characteristics from these registry records were abstracted and analyzed.

Results 
Of 1202 registries identified, approximately 47% reported LSI sponsorship. These 562 LSI registries varied in focus: medical devices (n = 193, 34%), specific drugs (n = 173, 31%), procedures (n = 29, 5%), or particular diseases (n = 139, 25%). Thirty-three registries (6%) evaluated pregnancy outcomes. The most common therapeutic area was cardiovascular (n = 234, 42%); others included endocrinology, immunology, oncology, musculoskeletal disorders, and neurology. The two most often measured outcomes were clinical effectiveness and safety, each of which appeared in 363/562 (65%) of LSI registries. Other outcomes included real-world clinical practice patterns (n = 122, 22%), patient-reported outcomes (n = 106, 19%), disease epidemiology/natural history (n = 69, 12%), and economic outcomes (n = 30, 5%). The number of LSI registries and their geographic diversity has increased over time.

Conclusions 
The LSI registries represent a substantial proportion of all patient registries documented in ClinicalTrials.gov. These prospective studies are growing in number and encompass diverse therapeutic areas and geographic regions. Most registries measure multiple outcomes and capture real-world data that may be unavailable through other study designs. This classification of LSI registries documents their use for studying heterogeneity of diseases, examining treatment patterns, measuring patient-reported outcomes, examining economic outcomes, and performing comparative effectiveness research. © 2014 The Authors. Pharmacoepidemiology and Drug Safety published by John Wiley & Sons, Ltd.

KEY WORDS—registry; ClinicalTrials.gov; industry; sponsor; pharmacoepidemiology

INTRODUCTION

Patient registries have been recognized as an important study design for tracking the natural history of diseases—including rare or orphan diseases—for understanding variations in clinical practice patterns and for assessing the safety of medical devices and medical therapies.¹ For example, the National Registry for Myocardial Infarction, although initiated primarily to track the safety of recombinant tissue plasminogen activator, was expanded to study broader clinical and healthcare system questions in collaboration with the American Heart Association (AHA) and the American College of Cardiology (ACC). This 16-year study has produced over 100 peer-reviewed publications and was recently highlighted for its contributions to improving quality of care and patient outcomes.² Outcome-focused patient registries have also recently been identified as an important element of the US national comparative effectiveness research (CER) initiative, with the Institute of Medicine highlighting the strength of such prospective observational studies for providing evidence representing actual practice and complementing clinical trials.³ In 2007, the Agency for Healthcare Research and Quality (AHRQ) published

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the first edition of *Registries for Evaluating Patient Outcomes: A User’s Guide*,
which helped to establish common terminology, quality standards, and best practices for conducting registry studies. The draft third edition of this Guide has added chapters focusing on registry science and state-of-the-art methods. Contributors to the Guide are a diverse group of researchers, content experts, program representatives, and stakeholders involved in the sponsorship, design, and implementation of registries.

Various types of organizations have sponsored patient registries, including medical societies, governmental organizations, academic collaboratives, and the life sciences industry (LSI). For example, the ACC, in partnership with other medical societies, sponsors a suite of registries within the National Cardiovascular Data Registry.5 Another prominent example is the long-running, cancer-focused, Surveillance, Epidemiology, and End Results program,6 which is sponsored by the US government’s National Cancer Institute. The National LymphoCare Study is a multicenter, longitudinal, patient registry in non-Hodgkin’s (follicular) lymphoma, which is sponsored by Genentech, and is governed by a steering committee composed of academic researchers, patient advocates, and company representatives.7 Many registries such as these have received widespread attention and have resulted in multiple scientific publications and presentations.

Despite the growing interest in such registries, there has not been a systematic evaluation of their role as a source of evidence. Understanding the nature and role of various sources of evidence is of particular interest to regulated industries such as the LSI, which includes medical device, biotechnology, and pharmaceutical companies. This is especially true in light of new regulatory requirements, healthcare reform, regulatory science,8 and evolving regulatory initiatives. Initiatives such as parallel review8 by regulators, the increasing role of health technology assessment authorities in reimbursement decision-making, and the maturing utilization of CER and patient-centered research represent a few of the fundamental shifts occurring in the landscape of LSI evidence development. With growing recognition of the need for a learning healthcare system,9 and as CER and patient-centered research contribute increasingly to medical science, it is important to examine sources of real-world medical evidence, including prospective, longitudinal registry studies sponsored by the LSI.

In the study presented in this paper, we examine the nature of LSI-sponsored registries (noted simply as LSI registries herein) and their characteristics, including trends and associated factors over time. We seek to address to what extent LSI registries have focused on particular medical technologies rather than more broadly on specific diseases, whether researchers have focused on particular therapeutic areas more than others, what kinds of outcomes were assessed, and what trends have emerged over time. The objective of this research is to identify and characterize LSI registries that are reported in ClinicalTrials.gov, so as to better understand the evolving role of registries in providing evidence that may fill requirements of regulators and payers and what role they may have in evaluating clinical practice and serving as a part of the research agenda to improve clinical care and patient outcomes.10 Our objective is roughly parallel to recent work that examined the characteristics and impact of interventional clinical trials registered in the ClinicalTrials.gov database.11

METHODS

Search techniques and study selection

To identify LSI registries, we searched the database at ClinicalTrials.gov, which included data from nearly 145 000 clinical research studies performed in 185 countries.12 In 1997, the Congress passed legislation requiring National Institutes of Health to create a registry of clinical trials; the website was formally released in February 2000. In 2005, the International Committee of Medical Journal Editors announced a policy requiring trial registration as a prerequisite for publication; this policy was followed by a large increase in the number of clinical trial registrations on ClinicalTrials.gov.13 In December 2007, this mandate was broadened, requiring ClinicalTrials.gov registration of all phase 2 through 4 drug trials and medical device trials14 a development facilitated by refinements to the site’s architecture, design, and software,15 which minimized concerns regarding potential quality control issues.16 In September 2008, the website added the ability to post study results. Prospective observational studies, including patient registries, are accepted by ClinicalTrials.gov, but submission is not a legal regulatory requirement.

The search of ClinicalTrials.gov for registries began in January 2012 and was completed in September 2012.12 The broad search used the term “registry” and the “Funded by Industry” qualification.

Inclusion and exclusion criteria were defined a priori. For inclusion, studies were identified if they were at least partially funded by an LSI company(s) and were listed in ClinicalTrials.gov with a registry component noted in the title, purpose, detailed description, treatment arm, primary outcome measure, or...
secondary outcome measure. The single exclusion criterion was a determination that the study was not of a registry design (defined as being prospective, observational, and longitudinal), despite including the term “registry” somewhere in the clinical trial record. Given this study was conducted of “studies”, not of individual patients/subjects, no ethics approval was needed.

Studies were reviewed by one author using these defined inclusion and exclusion criteria and validated by a second author. In the event of disagreement and lack of consensus, a third author was consulted.

Data collection

The following registry study-related data elements were pre-defined and collected from ClinicalTrials.gov: National Clinical Trial Number, Title, Recruitment, Study Results, Condition, Interventions (subsequently categorized as drug, device, procedure, disease, and pregnancy), Sponsor/Collaborator, Gender, Age Group, Phase, Enrollment size, Funding Sources, Study Design, Date First Received, Start Date, Primary Completion Date (if applicable), Date of Last Update, Date of Last Verified, Primary Completion Date, and Outcome Measures.

In addition to the aforementioned study characteristics, supplemental data from ClinicalTrials.gov and from published literature were collected to verify and clarify that the aforementioned data elements appropriately represented identified registry studies (as noted earlier). All information was systematically categorized by a study author and reviewed by additional study authors to ensure that the data elements were consistently recorded.

Data abstraction and categorization

At least two authors classified each registry according to the categories listed in the following text.

Registry type: The registry type was categorized on the basis of its primary focus. These categories included three types of interventions (drug, device, and procedure), as well as disease registries and pregnancy registries. Disease registries did not focus on a single drug, device, or procedure but may have collected information on these interventions throughout their assessment of a disease. Pregnancy registries were classified separately as they focus on a specific population (i.e., pregnant women), and their primary purpose was usually to study the potential impact of one or more pharmaceutical agents on outcomes of the pregnancy, fetus, and/or child.

Therapeutic area: The therapeutic area for each registry was classified using the “primary condition” term in ClinicalTrials.gov then mapped to the pertinent International Classification of Diseases, Ninth Revision, Clinical Modification code.17

Year of initiation: Studies were characterized by the year they were initiated, from 1981 through 2012. Although ClinicalTrials.gov was not available until 2000, some earlier studies were ongoing.

Geographic regions: As the data supported, registries were classified within one to seven geographic regions: Africa, Asia, Europe Big 5 (France, Germany, Italy, Spain, UK), Europe (other than the five most populous countries in Europe, includes Turkey), North America (USA and Canada), Australia/New Zealand, and Central America/South America.

Outcomes: Registries were classified as to which of the seven types of outcome measures were collected: disease epidemiology (natural history), practice patterns (diagnostic or therapeutic), clinical effectiveness, safety, patient-reported outcomes (PROs), pregnancy outcomes, and economic outcomes.

Examples of clinical effectiveness outcomes included overall survival or progression-free survival (e.g., in cancer) and incidence of primary or secondary events (such as acute myocardial infarction or stroke in cardiovascular disease). Safety outcomes included adverse events, serious adverse events, and immediate treatment complications. Disease epidemiology measures included incidence, prevalence, and risk factors of disease, as well as issues related to initial presentation and natural history or disease course progression. Practice patterns included the use of different diagnostic and therapeutic modalities and the timing, duration, and sequencing of that use as it may vary by different health system, patient, and provider characteristics. Pregnancy outcomes included birth defects and infant outcomes. Examples of PROs included health-related quality of life, functioning, and symptoms. Economic outcomes typically included healthcare resource utilization and HCRU-associated costs or broadly reported “economic outcomes.” Many registries collected data on multiple types of outcomes; all were captured and reported in our analysis.

Analysis

Data were analyzed descriptively, using counting and basic statistical functions in Microsoft® Excel (percents, medians, and ranges). Significance testing was calculated using the StatCalc chi-squared test function of EpiInfoTM software for data collection, analysis, and reporting made available by the US Centers for Disease Control and Prevention (http://www.cdc.gov/epiinfo, accessed 1 September 2013). Temporal trends

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were displayed graphically and analyzed using time-trend analysis. The resulting data summaries are presented in the text, tables, and graphs in the following text.

RESULTS

A search for registries in ClinicalTrials.gov yielded 1202 studies initiated between 1981 and 2012 (Figure 1). Of these, 590 were at least partly LSI-funded; seven of which included an industry and National Institutes of Health/other federal agency collaboration. After further review, 28 studies were excluded because they were not registries (20 referred to another registry in the trial record and eight inappropriately used the term “registry”). Therefore, 562 records qualified as LSI registries for the purpose of this analysis.

Registry types and temporal trends

Among the 562 LSI registries, 173 (31%) were classified as drug registries, 193 (34%) as device registries, 29 (5%) as procedure registries, 139 (25%) as disease registries, and 33 (6%) as pregnancy registries (Table 1). Drug, device, and procedure registries were not mutually exclusive, and six registries involved two or more such interventions. Although eight registries were retrospectively reported as being initiated between 1981 and 1999, since the initiation of ClinicalTrials.gov in 2000, the number of new registry studies increased annually \((p < 0.01)\). When stratified by registry type, drug, device, and disease registries (Figure 2) showed the greatest increase in number of new registries initiated a trend that continued through 2012, whereas pregnancy and procedure registries increased much more slowly.

Therapeutic areas and temporal trends

Cardiovascular registries were the most frequent by a substantial margin, making up 42% of all registries and 76% of medical device registries. Other common therapeutic areas included endocrine, metabolic, and immunologic (10%); cancer (9%); musculoskeletal and connective tissue (8%) and neurologic (5%).

Compared with registries in other disease areas, cardiovascular registries were more likely to be device registries \((p < 0.01)\), procedure registries \((p < 0.01)\), or disease registries \((p < 0.01)\) rather than drug registries. Drug registries were fairly well dispersed among several disease indications. Endocrine, metabolic, and immunologic disorders reported the greatest number of drug registries (18%), followed closely by cardiovascular (16%) and musculoskeletal and connective tissue disorders (13%) (Table 1). Most therapeutic areas experienced stable or increasing growth in the absolute number of registries initiated per year. The most dramatic increase was seen in the number of cardiovascular registry studies initiated in 2005–2006, with 10 registries initiated in 2005 and 29 in 2006.

Geographic regions and temporal trends

The majority of registries, initiated between the years 1981 through 2012, collected data in North America \((N=279)\), followed by the “Europe Big 5” region \((N=147)\), and “Europe (other)” region \((N=116)\) (Figure 3). A trend of an increasing proportion of studies in Asia \((p < 0.02)\), the Europe (other) region \((p < 0.03)\), and Central/South America \((p < 0.05)\) over the time periods is noted as well, particularly in the last 6 years. The vast majority of pregnancy registries \((28/33, 85\%)\) collected data within North America, followed by the Big 5 countries in Europe \((4/33, 12\%)\).

Outcomes and temporal trends

Registries were often designed to examine multiple outcomes (Table 2 and Figure 4). Among the 562 LSI registries, clinical effectiveness and safety were the most commonly collected outcomes, with 363/562 (65%) registries reporting collecting both. Also, clinical effectiveness and safety reporting demonstrated the most impressive growth. Other outcomes were collected less often, and usage increased over time at a slower pace. Real-world practice patterns, the epidemiology or natural history of a disease, and economic outcomes were reported in 122 (22%), 69 (12%), and 30 (5%) of registries, respectively. PROs were reported in 106/562 registries (19%) overall, but cardiovascular registries, the most commonly

Figure 1. Schematic of the registry search and categorization process.
*Categories are not mutually exclusive
represented disease area, were less likely to report PROs than were other registries \(p < 0.01\). Pregnancy outcomes were reported in only 33/562 registries. Of these 33 pregnancy registries, 32 focus on outcomes following pharmaceutical or vaccine exposure. The one exclusively obstetrics registry investigated effectiveness outcomes of in vitro fertilization (frozen embryo success). Clinical safety outcomes were most commonly assessed in vaccine registries (54%), followed by cardiovascular (41%), genitourinary (38%), digestive (36%), hematologic (35%), and complications of surgical and medical care (35%).

**DISCUSSION**

This analysis documents the large number of LSI patient registries, representing nearly half of all registry studies listed in ClinicalTrials.gov. The research also confirms the rapid growth of LSI registries over time, with increases in both the absolute number of registries and
the therapeutic areas represented. Our research suggests that LSI registries are characterized by diversity of purpose and of outcomes assessed. Overall, these findings likely reflect a growing demand for rigorous real-world evidence from health care stakeholders, including payers, regulators, clinicians, and policy and guidelines developers. Our study of observational registries complements recent work that found a trend for an increasing number of interventional clinical trials over time.11

Table 2. Outcome measurements by therapeutic area for 562 Life Science Industry patient registries

| Therapeutic area                        | Clinical effectiveness N = 363 | Clinical safety N = 363 | Practice patterns* N = 122 | PROs** N = 106 | Disease epidemiology† N = 69 | Pregnancy N = 33 | Economic outcomes‡ N = 30 | Total registries N = 562 |
|----------------------------------------|-------------------------------|------------------------|---------------------------|-----------------|-----------------------------|-----------------|-----------------------------|--------------------------|
| Cardiovascular                         | 159 (38%)                    | 171 (41%)              | 36 (9%)                   | 16 (4%)         | 23 (6%)                     | —               | 11 (3%)                     | 234                      |
| Endocrine, metabolic, and immunologic  | 41 (31%)                     | 38 (28%)               | 28 (21%)                  | 16 (12%)        | 6 (5%)                      | 3 (9%)          | 2 (2%)                      | 56                       |
| Cancer                                 | 33 (32%)                     | 22 (21%)               | 25 (24%)                  | 10 (10%)        | 10 (10%)                    | 2 (6%)          | 2 (2%)                      | 50                       |
| Musculoskeletal and connective tissue  | 32 (36%)                     | 25 (28%)               | 6 (7%)                    | 18 (20%)        | 1 (1%)                      | 5 (15%)         | 2 (2%)                      | 46                       |
| Neurologic                             | 11 (23%)                     | 12 (26%)               | 3 (6%)                    | 8 (17%)         | 4 (9%)                      | 9 (27%)         | —                           | 30                       |
| Infectious disease                     | 13 (31%)                     | 13 (31%)               | 3 (7%)                    | —               | 7 (17%)                     | 6 (18%)         | —                           | 26                       |
| Hematologic                            | 17 (32%)                     | 19 (35%)               | 5 (9%)                    | 5 (9%)          | 5 (9%)                      | 1 (3%)          | 2 (4%)                      | 23                       |
| Digestive                              | 17 (38%)                     | 16 (36%)               | 1 (2%)                    | 7 (16%)         | 2 (4%)                      | —               | 2 (4%)                      | 22                       |
| Mental health                          | 11 (24%)                     | 11 (24%)               | 7 (16%)                   | 6 (13%)         | 4 (9%)                      | 3 (9%)          | 3 (7%)                      | 19                       |
| Complications of surgical and medical care | 9 (39%)                     | 8 (35%)               | —                         | 5 (22%)         | 1 (4%)                      | —               | —                           | 13                       |
| Psoriasis and dermatologic             | 4 (15%)                      | 9 (33%)                | 3 (11%)                   | 5 (19%)         | 3 (11%)                     | 1 (3%)          | 2 (7%)                      | 11                       |
| Vaccine                                | 2 (15%)                      | 7 (54%)                | 1 (8%)                    | —               | 2 (15%)                     | 1 (3%)          | —                           | 11                       |
| Genitourinary                          | 6 (38%)                      | 6 (38%)                | —                         | 4 (25%)         | —                           | —               | —                           | 8                        |
| Injury and poisoning                   | 4 (29%)                      | 1 (7%)                 | 3 (21%)                   | 2 (14%)         | 1 (7%)                      | —               | 3 (21%)                     | 5                        |
| Respiratory                            | 2 (22%)                      | 3 (33%)                | 0 (0%)                    | 3 (33%)         | 0 (0%)                      | 1 (3%)          | —                           | 5                        |
| Renal                                  | 2 (29%)                      | 2 (29%)                | 1 (14%)                   | 1 (14%)         | —                           | —               | 1 (14%)                     | 2                        |
| Obstetrics                             | —                            | —                      | —                         | —               | 1 (3%)                      | —               | —                           | 1                        |

*Real-world measurements of diagnostic and/or therapeutic practice patterns.
**Patient-reported outcomes (PROs): health reported quality of life (HRQoL), adherance, and satisfaction.
†Measurements of the natural history of disease.
‡Resource utilization, cost of utilities, and other non-specified economic outcomes.
Between 2004 and 2006, the number of LSI registries listed in ClinicalTrials.gov more than doubled. Although this period occurred soon after ClinicalTrials.gov was initiated in 2000, this research finding is not likely solely based on increased reporting. To verify the increase in LSI registries observed in this study, we also searched high-profile medical congress proceedings at the time of the ClinicalTrials.gov search for LSI registries: ACC, AHA, the American Society of Clinical Oncology, the American Association for Cancer Research, and the American Society of Hematology. The number of abstracts presented in these meetings from LSI registry studies showed a similar pattern of increasing prevalence. For example, searches for the term “registry” OR “registries” in the 1997, 2007, and 2012 AHA proceedings yielded 3, 64, and 110 abstracts, respectively, whereas the American Society of Clinical Oncology searches in the same years yielded 0, 11, and 33 hits, respectively.

Although the preponderance of medical device registries was related to cardiovascular care, LSI non-device registries were distributed across many therapeutic areas, suggesting that the importance or value of registries extends to most, if not all, therapeutic areas and physician specialties.

As noted earlier, LSI registries examine a wide array of outcomes. Although clinical effectiveness and safety are evaluated in the majority of the registries assessed, it is not clear to what extent LSI registries were initiated voluntarily or in response to specific regulatory or payer requirements. Currently, the ClinicalTrials.gov database does not document whether studies are mandated in whole or in part, so future assessment will require examination of other data sources, such as FDA or European Medicines Agency documents or AHRQ’s new Registry of Patient Registries (RoPR).

Although the absolute number of LSI registries has grown remarkably, the relative proportion focusing on each of the various outcomes or exposures has remained relatively stable since 2003. Given increasing societal concern on the continued rise in healthcare costs, it was surprising that only 19 out of 562 registries reported collecting economic information. This could be due to underreporting of such outcomes in ClinicalTrials.gov, a preferential focus of sponsors on clinical outcomes, and/or a time lag between the growing demand by payers for real-world data and the use of registries for that purpose.

Pregnancy registries remain a constant but a relatively small proportion (<6%) of the evaluated studies. Nevertheless, rigorously derived data from pregnancy registries meet an important public health need, because pregnant women are usually excluded from clinical trials. The current data show continued use of pregnancy registries to fill this important evidence gap.

The diversity of purpose of LSI registries demonstrates the important role of observational studies and real-world evidence because they offer a variety of insights and value in addition to elaborating the real-world safety profile of pharmaceuticals and medical technologies. LSI registries are collaborations with...
Because our research did not include registries outside the USA, only registries outside the USA required to be registered in the USA by the FDA. These requirements, as well as exploration of new approaches to registry collaborations and partnerships, are important questions to address in future research. Future research should also attempt to evaluate the quality of registry design and execution, in relation to the evidence requirements for the range of purposes and outcomes identified by our research, including quality improvement, or even personalized medicine, but an objective examination may be facilitated by these new data sources.

In addition to ClinicalTrials.gov, the RoPR and PubMed were assessed as potential registry data sources. The RoPR database, initiated by AHRQ in December 2012, is intended to collect more comprehensive data on all registries and should help in addressing questions about representativeness. The newly developed AHRQ Registry of Patient Registries should eventually provide a useful way to document and search for patient registries. At this point, however, it contains relatively few entries. The European Medicines Agency established the European Network of Centres for Pharmacoepidemiology and Pharmacovigilance (ENCePP) in 2006 to facilitate studies of safety and benefit/risk and released a database in 2010 where all post-authorization safety studies are required to be registered. The expanded datasets in RoPR and ENCePP will provide more detailed data for future studies of registries. Searching PubMed for patient registries was also not ideal for several reasons. First, the variations in “registry” nomenclature decrease both the sensitivity and specificity of these searches. Additionally, LSI sponsors may have different publication output for different types and durations of patient registries. For example, it is possible to publish multiple manuscripts from a single registry; on the other hand, other registries may produce a limited number or no peer-reviewed publications. Finally, PubMed captures publications, although data sources are not consistently identified. So, searching on a specific registry name may not yield all publications that resulted from it. In combination, these challenges and considerations led the present research efforts to focus on registries cataloged in ClinicalTrials.gov.

This study suggests several important lines of investigation for research including use of additional sources, studies of methodological rigor, and evidence requirements, as well as exploration of new approaches to registry collaborations and partnerships. Future research on registries, LSI or other, will be able to examine new sources of detailed study information, including the RoPR and ENCePP databases, once sufficient data are accumulated. Publications databases, including PubMed, may allow examination of the contribution of these studies to the evidence base. There will be methodological challenges to overcome in seeking to integrate findings across sources. For example, inconsistent use of the term, registry, in PubMed makes it difficult to achieve a sufficiently sensitive literature search with the necessary specificity. An important question to address in future research is what are the drivers of the growth in registries? We can speculate this growth may be in response to the increasing need for real-world evidence (e.g., for the purposes of CER, patient-centered research, quality improvement, or even personalized medicine), but an objective examination may be facilitated by these new data sources.

Future research should also attempt to evaluate the quality of registry design and execution, in relation to the evidence requirements for the range of purposes and outcomes identified by our research, including quality improvement registries, regulatory safety studies, and CER. Recent consensus documents have attempted to identify the characteristics of “good quality” in such studies and as evidenced by documents produced.
by AHRQ\textsuperscript{4} and Patient-Centered Outcomes Research Institute (PCORI).\textsuperscript{25} It will be important to perform such a study.\textsuperscript{26} As noted earlier, this will require more information than that which is available in ClinicalTrials.gov.

Finally, to the extent that LSI-sponsored registries overlap in purposes and outcome measures with registries carried out by academia, government, and other research institutions, a number of issues are raised. For example, to help avoid competition for patients, as well as to possibly maintain or enhance the rigor of registry design and conduct, future efforts should be made to explore the opportunity for collaboration between pharmaceutical and other LSI companies, government, academia, and research institutions in co-developing and co-sponsoring registries. The relationship of registries to various forms of research collaborations and research networks and the learning healthcare system should also be explored. One of the most promising frontiers of research is the ability of registries to become platforms to support more effective planning and conduct of clinical trials.

As noted earlier, our study of observational registries complements recent work that found a trend for an increasing number of interventional clinical trials over time.\textsuperscript{11} Taken together, these results appear to reinforce a general trend for increasing demands for evidence from both clinical trials and observational registries—but there may be intrinsic limits to the capacity of the prospective clinical research enterprise, likely due to multiple factors (e.g., availability of patients, and funding). Thus, there is a need for continuing research to better understand the evidence needs and requirements of health care stakeholders and ensure that a systematic approach is taken to coordinated planning and conduct of evidence development programs. There are a number of examples of collaborative research programs that benefit from multiple perspectives in the design and conduct of studies, as well as in the sharing of costs and administrative overhead. On the basis of our findings of the increasing demand for evidence, we anticipate that the trend will be toward new and evolving forms of research collaboration.

While more research needs to be carried out, the synthesis of information presented here provides new and important information regarding the current utilization of LSI registries. The ability to identify sponsorship and to systematically and consistently assess the data elements provided in ClinicalTrials.gov provides a strong basis for the analyses performed, and the current landscape of such studies provides a preview of potential applications in CER and in the development of guidelines for clinical practice and improving disease management and patient outcomes.

**CONCLUSIONS**

This analysis of LSI patient registries cataloged in ClinicalTrials.gov documents the large number of such registries, and confirms the growth in their number over time, across many different therapeutic areas, and geographically across the globe. Far from being a narrow type of clinical study, perhaps focused on a particular safety concern, this analysis shows the body of LSI registries to be characterized by a diversity of purpose and types of outcomes assessed. Real-world comparative effectiveness is measured in most LSI registries, and over time, attention is being given to patient-centered outcomes and, to a lesser extent, economic costs. The information presented here provides support for the evolving nature of LSI registries, and the increasing importance and perceived value of such studies as part of a comprehensive approach to CER, complementary and synergistic with clinical trials. Future lines of research should explore the relationship of registries to research networks and platforms for planning and conduct of clinical trials.

**CONFLICT OF INTEREST**

At the time of project initiation, K. T., R. H. S., M. D. B., C. L. P., and B. R. L. were employed by Evidera or United BioSource Corporation, which received funding from Genentech and the PACE Initiative to conduct this research. C. E. B and M. S. B were employed by Genentech, a sponsor of this research. Dr Pashos is currently with Takeda Pharmaceuticals International. Dr Luce is currently the chief science officer at PCORI. The views expressed in this article do not necessarily represent those of PCORI.

**KEY POINTS**

- This research represents the first description of the collective characteristics and temporal trends of life sciences industry (LSI)-sponsored registries listed in ClinicalTrials.gov.
- The number of LSI-sponsored registries has grown substantially over time, with over 562 registered in ClinicalTrials.gov, 255 of which are currently enrolling.
- LSI-sponsored registries in ClinicalTrials.gov span six continents and examine multiple outcomes, including disease natural history, clinical practice patterns, effectiveness, safety, patient-reported outcomes, and economic outcomes.
ETHICS STATEMENT

The authors state that no ethical approval was needed.

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