CHAPTER

FEASIBILITY AND EDUCATIONAL VALUE OF A STUDENT-RUN PHARMACOVIGILANCE PROGRAMME – A PROSPECTIVE COHORT STUDY

Tim Schutte
Jelle Tichelaar
Michael O. Reumerman
Rike van Eekeren
Leàn Rolfes
Eugène P. van Puijenbroek
Milan C. Richir
Michiel A. van Agtmael

Drug safety
2017 May;40(5):409-418
doi: 10.1007/s40264-016-0502-1
ABSTRACT

Introduction: Pharmacovigilance, the monitoring of drug safety after marketing approval, depends highly on the adequate reporting of adverse drug reactions (ADRs). To improve pharmacovigilance awareness and future ADR reporting among medical students, we developed and evaluated a student-run pharmacovigilance programme.

Methods: In this project, teams of medical students (1st-5th year) assessed real ADR-reports as submitted to the national pharmacovigilance centre. After assessment of causality, including identification of a potential pharmacological explanation for the ADR, they wrote a personalized feedback letter to the reporter and a summary for the EMA and WHO pharmacovigilance databases. This student assessment was then verified and evaluated by Lareb staff, using an E-questionnaire. Student attitudes, intentions, skills, and knowledge of ADR reporting were evaluated with an E-questionnaire before and after participation.

Results: From May 2014 to January 2015, 43 students assessed 100 different ADR reports selected by Lareb staff (n=3). Student assessments were rated as useful (93%), scientifically substantiated (90%), accurate (92%), and complete (92%), and, on average, did not cost Lareb staff extra time. Medical students were positive about ADR reporting. Their awareness of ADR reporting increased significantly following participation (p<0.05). After participation the students intended to report serious ADRs in their future practice and their knowledge of pharmacovigilance and ADR reporting showed that they had a high overall level of pharmacological understanding.

Conclusion: The student-run pharmacovigilance programme is a win–win venture. It offers students a valuable “pharmacovigilance experience”, creates awareness in future doctors, and has the potential to increase pharmacovigilance skills and knowledge.
INTRODUCTION

Millions of patients annually experience an adverse drug reaction (ADR) and with an increasing use of medicinal drugs also the number of ADRs is increasing [1]. ADRs can range from minor harm to full anaphylaxis and even death and may cause hospital admission, patient burden, and costs [1-4]. Although drug registration protocols require sound (pre)clinical testing of the safety and ADRs of new drugs, relatively little is known about these aspects in real life circumstances before the drugs are given marketing approval [1, 3]. The monitoring/surveillance of ADRs after marketing approval (pharmacovigilance) is essential for identifying previously undetected, uncommon, or serious ADRs, and for improving understanding of drug risk profiles and medication safety [5, 6]. Pharmacovigilance centres have a major role in the post-marketing monitoring of drug safety, which is based on spontaneous (or voluntary) reporting in many countries [7]. Clinical observations both from patients and healthcare professionals serve as a starting point for reporting suspected ADRs. Most reported suspected ADRs are reported by health professionals, but also by patients [7]. This means that health professionals should have sufficient knowledge, adequate abilities, and a positive attitude to evaluating and reporting possible ADRs encountered in daily practice. They are encouraged, and in some countries legally obliged, to report serious and unknown ADRs to the competent authority [8, 9]. Although ADR reporting is a professional responsibility, the rate of underreporting is high and this hinders optimal ADR monitoring [7, 10, 11]. Previous studies have identified multiple factors as underlying the low level of ADR reporting: indifference, lack of motivation, lack of knowledge, negative attitudes, misconceptions, and difficulty in accessing forms [11].

While medical and pharmacy students recognize the importance of ADR reporting and express the intention to report ADRs [12, 13], they are insufficiently prepared to handle ADRs and have inadequate pharmacovigilance skills and knowledge [12-14]. This may hamper optimal patient care and the safe use of drugs. Thus there is a need to raise awareness, knowledge, and skills in recognising, managing and reporting ADRs. While several interventions have proven effective for practising health professionals [3, 15], only a few interventions focus on future health professionals such as medical or pharmacy students [15-17]. Most of these interventions have a theoretical basis (lectures), whereas students have indicated that they prefer active forms of learning [12-14]. Among trainee general practitioners, a practice-based method led to more and better-documented ADR reports than a lecture-based approach [18]. Such exposure and practice are known to be necessary to master clinical skills, “practice makes perfect” [19].

A practice-based and innovative approach for medical students could be the learner-centred student-run clinic (LC-SRC), which is based on the conceptual framework of “learning by doing” [20]. In the LC-SRC, medical students get the opportunity and responsibility to contribute to a real clinical task, such as a consultation with a patient [21]. In this way, they practice clinical skills (such as prescribing) in a real context-based situation as early as possible in their medical education [22]. To meet students’ wishes for an active learning approach, we postulated that a pharmacovigilance project within the existing LC-SRC would facilitate the development of students’ pharmacovigilance attitudes, knowledge and skills in recognising, managing and reporting ADRs in real-life clinical practice.

The aim of this project was to increase the pharmacovigilance awareness and skills of medical students, so that they would recognize and be able to manage and report ADRs in their future practice. The primary objectives were to analyse (I) the feasibility of the LC-SRC pharmacovigilance programme and (II) the educational value of such a programme in terms of students’ pharmacovigilance skills and knowledge.

METHODS

This prospective cohort study involved the Pharmacotherapy Section, Department of Internal Medicine of the VU University Medical Center (VUmc), Amsterdam, the Netherlands, and the Netherlands Pharmacovigilance Centre Lareb (Lareb). Lareb is responsible for the collection and analysis of ADRs to medicines and vaccines, and for education on medication safety in the Netherlands. The pharmacovigilance programme was set up in April 2014 as an initiative within the LC-SRC of the VUmc. The overall aim of the LC-SRC is to improve undergraduate pharmacotherapy education [22].

Setting

From May 2014 to January 2015, the LC-SRC received three anonymized ADR reports weekly from Lareb. The reports had been selected (by Lareb staff) for their suitability regarding adequate documentation, relevance, and potential underlying pharmacological mechanism. This selection was in accordance with the educational aim of the project. The LC-SRC project was coordinated by students with experience in the LC-SRC who volunteered to take on a coordinating role. These coordinators added information, including a student’s manual, step-by-step assessment form, and additional database information. Furthermore, they gave guidance and made appointments weekly with the student teams (3-6 participants) to provide feedback (see figure 1). Student teams had 6–10 days to assess the causality of the ADR, to study the potential pharmacological mechanism, write a personalized feedback letter to the ADR reporter, and write a summary for the pharmacovigilance databases of the European Medicines Agency (EMA) and WHO. Students were allowed to use any resource (e.g. Summary of Product Characteristics (SmPC), Uptodate®, Micromedex®), of which the latter three are regularly used by the Lareb assessors. After a final evaluation, the student-coordinator e-mailed the final ADR assessment to an assessor at Lareb, where the assessment and concept feedback letter were reviewed. The Lareb assessor also provided feedback on the assessment and sent the final feedback letter to the students to optimize learning.
with pharmacovigilance and ADR reporting before they took part in the programme. Besides providing information about their characteristics (student number, sex, study year), students also answered an open question about how they would manage a suspected ADR. Closed questions were asked about their awareness of ADRs and ADR reporting.

**Student post-participation E-questionnaire**

After participation, students completed a more detailed (10 minutes, 15 questions) E-questionnaire to assess their role and progress in ADR management and their opinion about their pharmacovigilance training and the student-run pharmacovigilance programme. The questionnaire also focused on student attitudes and intentions regarding ADR reporting. These multiple-choice questions (7-point Likert scale) were based on the Dutch national pharmacovigilance study [12], and the studies of Gavaza et al. [13, 23, 24]. As in the national study [12], open-ended questions and dichotomous questions were used to investigate students’ knowledge and skills regarding basic pharmacovigilance and ADR reporting. Additional open-ended questions about pharmacovigilance knowledge were added: “what is the meaning of the black triangle on the packaging of medications?”, “what resources can you use to see if an ADR is known?”, “what does a positive de- or re-challenge mean?”, and “which patient-related factors could play a role in the development of an ADR?”

**Data analysis**

Data were analysed using SPSS Statistics 22 (IBM Corp.; Armonk, New York). Descriptive statistics were computed for the student and supervisor populations, assessment rating, and student outcomes. Student outcomes were analysed based on the levels of Kirkpatrick’s hierarchy [25] and were divided into three groups: intentions/attitudes, knowledge and skills of ADR reporting. Student open-ended questions were analysed using content/thematic analysis. Student responses on the questions in both the pre- and post-questionnaire (where, why, and what to report and what they would do if they encountered an ADR) were analysed using a generalized estimating equation analysis (GEE analysis) to test if participation improved pharmacovigilance skills and knowledge. The GEE analysis has several advantages compared to a repeated measures t-test (e.g. homogeneity of variance is not necessary and no loss of information when parts of longitudinal data are missing). Results of changes in responses (pre–post) are displayed in absolute differences (%). An one-way ANOVA was used to compare the mean intention scores for reporting in 3 different situations (serious, unknown and all ADRs). A significance level with an alpha of 5% was considered statistically significant (p <0.05) for all analyses.

**Ethical aspects**

All ADR-reporters agreed to the Lareb privacy statement (http://www.lareb.nl/Footer/Privacy). The ADR reports were anonymously forwarded to the students by Lareb staff. The institutional review board of the VU University Medical Center reviewed the research protocol and concluded that the study did not fall under the scope of the Dutch Medical Research Involving Human
Students' outcomes — skills and knowledge (longitudinal study)  

A total of 29 (67.5%) participants completed the E-questionnaire before and after participation. The characteristics of the study participants are available in Electronic Supplementary Material 2. Before participation, most students (89.7%) were aware of the reasons for ADR reporting, although only 62.1% of students knew where to report ADRs and fewer (27.6%) knew what information was needed to fill in the ADR report. After participation in the pharmacovigilance programme, students knew better where to report.

**RESULTS**

In total, 100 ADR reports were assessed by 43 medical students working in teams. The students assessed 1 to 10 (Mean 2.9; SD 2.7) ADR reports. 87 reports originated from healthcare providers and 13 from patients. In total, 115 drugs were mentioned, antidepressants (16%) and antibiotics (11%) were the main drug groups reported. Sixty-two percent of the suspect drugs were non-essential drugs, defined as not being included in the 19th WHO essential medication list [26].

The ADR reports mentioned 148 different symptoms, neurological (13%) and psychological (12%) symptoms were the most commonly reported events.

All student assessments of the ADR reports were remotely supervised and evaluated by Lareb staff (n=3), using an E-questionnaire (see Table 1). They rated the assessments as being useful/very useful in 93% of the cases (mean 4.58, SD 0.65), scientifically substantiated in 90% (mean 4.49, SD 0.73), and complete (as in "not lacking important information") in 92%; 92% of the reports did not contain inaccuracies. The overall assessment was scored 8.29 (SD 1.15) out of 10 (max). The Lareb staff indicated that the student assessments saved time in 33% of the cases, were time neutral in 66% of the cases, and cost them extra time in 11% of cases.

<table>
<thead>
<tr>
<th>Assessment rating</th>
<th>N</th>
<th>Mean (SD)</th>
<th>Fully disagree</th>
<th>Neutral</th>
<th>Fully agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Useful assessment</td>
<td>100</td>
<td>4.58 (0.65)</td>
<td>1</td>
<td>6</td>
<td>27</td>
</tr>
<tr>
<td>Scientifically substantiated assessment</td>
<td>100</td>
<td>4.49 (0.73)</td>
<td>2</td>
<td>8</td>
<td>61</td>
</tr>
<tr>
<td>Time spent verifying the student ADR-assessment, compared to self-handling</td>
<td>100</td>
<td>2.78 (0.77)</td>
<td>3</td>
<td>30</td>
<td>56</td>
</tr>
<tr>
<td>Total assessment rating</td>
<td>100</td>
<td>8.29 (1.15)</td>
<td>2</td>
<td>16</td>
<td>82</td>
</tr>
</tbody>
</table>

Table 1: Rating of student assessments by Lareb staff.

**Figure 2:** Students' responses to where, what, and why to report a suspected adverse drug reaction (ADR) pre and post participation in the student-run pharmacovigilance programme. Statistical significant difference is indicated with an asterisk. n.s.: non statistical significant difference.

ADRs (+37.9%, p<0.05) and what was needed for a qualitatively good report (+55.2%, p<0.05). More students knew why ADRs should be reported to Pharmacovigilance centre Lareb, however this improvement was statistically non-significant (+6.9%, p>0.05) (see figure 2). How the students would respond to an ADR in one of their patients did not change significantly after programme participation. In Table 2 the specific actions students suggested to take before and after participation are displayed.
Situations are displayed in Table 3.

After participation, all (n=29) students intended to report serious (mean 6.38, SD 0.73) and unknown ADRs that I encounter to the competent authority. Lower part of table: Student intentions and attitudes to report adverse drug reactions (ADRs). Upper part: Student intentions to report serious, unknown and all encountered ADRs to the competent authority (*statistical significant difference). Lower part of table: Student behaviour beliefs towards reporting an ADR.

### Knowledge and skills

Over three quarters (82.8%) of the students knew which items are necessary for a qualitatively good ADR report and mentioned the SmPC (60.7%), Farmacotherapeutisch Kompas (Dutch independent medication information system for health professionals) (57.1%), and the website of the Netherlands Pharmacovigilance Centre Lareb (50%). Micromedex®, Pubmed, and other resources (e.g. books and an ADR and GEE analysis outcome of statistical difference).

### Table 2

Students' response when encountering an adverse drug reaction.

<table>
<thead>
<tr>
<th>Pre (n=29)</th>
<th>Post (n=29)</th>
<th>Sig (CI 95%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Search for additional information</td>
<td>62.1% (18/29)</td>
<td>76.7% (22/29)</td>
</tr>
<tr>
<td>Search for an alternative drug</td>
<td>27.6% (8/29)</td>
<td>30.0% (8/27)</td>
</tr>
<tr>
<td>Discontinuing the suspected drug</td>
<td>24.1% (7/29)</td>
<td>20.0% (6/30)</td>
</tr>
<tr>
<td>Altering (lower) dose of suspected drug</td>
<td>17.2% (5/29)</td>
<td>10.0% (3/30)</td>
</tr>
<tr>
<td>Depends of severity/indication</td>
<td>20.6% (6/29)</td>
<td>10.0% (3/30)</td>
</tr>
<tr>
<td>Report to pharmacovigilance centre</td>
<td>31.0% (9/29)</td>
<td>43.3% (13/30)</td>
</tr>
<tr>
<td>Communication with patient</td>
<td>3.4% (1/29)</td>
<td>6.7% (2/30)</td>
</tr>
</tbody>
</table>

### Table 3

Student outcomes (post-participation)

Intention

After participation, all (n=29) students intended to report serious (mean 6.38, SD 0.73) and unknown ADRs (mean 6.31, SD 0.81), but were less prepared (one-way ANOVA, p<0.05) to report all ADRs encountered (mean 2.93, SD 1.22) to the competent authority. Six students (21%) had already reported at least one ADR to Lareb. Student intentions towards ADR reporting in different situations are displayed in Table 3.

Attitudes

The students had a high score for attitude about reporting ADRs after participation, and students rated “contributing to medication safety” (mean 6.31, SD 0.66, 7-point Likert scale) as the main reason to report ADRs. “Improving patient safety” (mean 6.21, SD 0.77) and “educating others about drug risks” (mean 5.93, SD 0.92) were also important reasons. Students did not believe reporting ADRs could “break trust with patients” (mean 2.14, SD 0.74) or “increase the risk of malpractice” (mean 2.72, SD 1.33). Student attitudes towards ADR reporting in different situations are displayed in Table 3.

### Table 2

Students acquired skills and knowledge (longitudinal). Upper part of table: Student skills and knowledge to adequately report a suspected ADR (*statistical significance between pre and post-participation). Lower part of table: Student skills and knowledge tests are available in Electronic Supplementary Material 2). Co-medication (72.4%), a description of the reported ADR(s) (62.1%), and knowledge of general pharmacovigilance of 82.5% for dichotomous questions, uncorrected for guessing, and 53.5% for open questions. The items with the highest scores were reporter’s identity and reporter’s identity and reporter’s identity and reporter’s identity.

### Table 3

Students’ response when encountering an adverse drug reaction.
necessity of reporting even if all relevant information was not available. Incorrect answers were given most often to the questions about understanding of the term “pharmacovigilance” and the explanation of a “de-challenge or re-challenge”. After participation, 75.9% of the students knew that patients and/or medical students could report ADRs (even during their clerkships).

**Students’ reflections on participating**

Overall, students valued the pharmacovigilance programme. The students responded to have learned skills such as performing an ADR assessment (n=10) and searching and assessing scientific literature (n=9) in response to the open question what they had learned by participating in the programme (see Table 4). Other subjects they reported to have learned included the importance of reporting ADRs (n=7), and general pharmacological knowledge (n=6). Students found assessing ADR reports educational (mean 4.33, SD 0.88), more instructive than fictive casuistry (mean 4.22, SD 0.70), and felt responsible for assessing the ADR reports (mean 4.22, SD 0.80). They did not consider that their current curriculum covered pharmacovigilance well (mean 2.70, SD 1.03) and thought that more pharmacovigilance education was needed (mean 3.96, SD 0.94). They thought that assessing ADR reports should be included in their curriculum (mean 3.93, SD 0.78).

<table>
<thead>
<tr>
<th>Theme</th>
<th>Quotations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Intentions &amp; attitudes</strong></td>
<td></td>
</tr>
<tr>
<td>Importance of reporting (n=7)</td>
<td>“That a lot is learned about medication by reporting ADRs”</td>
</tr>
<tr>
<td></td>
<td>“The importance of reporting ADRs and assessing them properly”</td>
</tr>
<tr>
<td>Pharmacovigilant attitude (n=2)</td>
<td>“To better look at the medications patients are using: Many new patient complaints could be better explained by adverse drug reactions instead of a new diagnosis”</td>
</tr>
<tr>
<td><strong>Knowledge</strong></td>
<td></td>
</tr>
<tr>
<td>Pharmacological knowledge (n=6)</td>
<td>“The existence of dangerous interactions between certain drugs”</td>
</tr>
<tr>
<td></td>
<td>“additional pharmacological knowledge and knowledge regarding the specific mechanism of action in the ADR reports I assessed”</td>
</tr>
<tr>
<td>Knowledge regarding adverse drug reactions (n=4)</td>
<td>“I learned about the physiology/mechanisms that underlie an adverse drug reaction”</td>
</tr>
<tr>
<td></td>
<td>“I know more about the side effects of several drugs”</td>
</tr>
<tr>
<td>Getting to know Lareb (n=1)</td>
<td>“The existence of pharmacovigilance center Lareb”</td>
</tr>
<tr>
<td><strong>Skills</strong></td>
<td></td>
</tr>
<tr>
<td>Performing an ADR assessment (n=10)</td>
<td>“what happens if you have reported an ADR”</td>
</tr>
<tr>
<td></td>
<td>“I have learned how I can assess the causality of an suspected adverse drug reaction”</td>
</tr>
<tr>
<td>Searching and assessing scientific literature (n=9)</td>
<td>“Searching for evidence-based literature regarding an adverse drug reaction”</td>
</tr>
<tr>
<td></td>
<td>“I also learned which sound information sources are available”</td>
</tr>
<tr>
<td>Reporting an ADR (n=8)</td>
<td>“How and where to report an adverse drug reaction”</td>
</tr>
<tr>
<td>Writing a scientific substantiated feedback letter (n=2)</td>
<td>“To write a medical feedback letter that is short and concise”</td>
</tr>
<tr>
<td></td>
<td>“To write a clear pharmacological explamation of the ADR and to write a feedback letter to the reporting physician”</td>
</tr>
</tbody>
</table>

Table 4: Quotations / statements by participating students regarding what they learned as response to the open question “What have you learned by participating in the student-run pharmacovigilance programme?” See Electronic Supplementary Material 1. Themes are sorted based on Kirkpatrick’s hierarchy and were divided into three groups: intentions/attitudes, knowledge and skills.

**DISCUSSION**

This study shows that undergraduate medical students can make high-quality (useful, scientifically substantiated, accurate, and complete) assessments of ADR reports, without costing Lareb staff extra time. Moreover, the programme improved the pharmacovigilance skills and awareness of future health professionals and provided the opportunity to give instruction on basic and clinical pharmacovigilance skills and knowledge. The programme gives undergraduate medical students the unique opportunity to participate in real pharmacovigilance practice. Therefore, the feasibility criteria were met and the student-run pharmacovigilance programme appears to be a win–win venture for both Lareb and medical students.

It is surprising that the medical students provided such high-quality assessment because ADRs are perceived as a difficult subject in pharmacotherapy practice and education. There are no previous studies of students contributing to pharmacovigilance by assessing ADR reports, and so we could not compare our findings with those of other studies. However, in an earlier study undergraduate students were able to solve difficult pharmacotherapy problems and performed at junior doctor level in a LC-SRC [21]. This might be because students respond well to the opportunity and responsibility to contribute to a real clinical task early in their medical education, showing greater intrinsic motivation and willingness to invest time and energy voluntarily [27,28].

In general, supervising the student assessments, comprising selection of useful reports for the programme and rephrasing feedback letters to professional communication cost little extra time compared to a full assessment by Lareb staff themselves. This is an essential finding because it helps to secure the future of this project and is an important condition for the win–win venture between students and Lareb. Only 11% of the ADR reports cost Lareb staff extra time, but this was not because the reports were of poor quality but because the extensive and in-depth reports prepared by the students necessitated Lareb staff taking extra time to check the additional referenced literature/resources. These reports were awarded high marks (data not shown).

The programme raised the pharmacovigilance awareness of future health professionals, an essential aspect of rational prescribing and medication safety. Nearly all the participating students knew where, why, and what was needed for a qualitatively good report. Compared with earlier studies, the students participating in our programme had a more positive attitude towards reporting serious and unknown ADRs and had higher intention scores than pharmacists, pharmacy, and medical students [12, 13, 23]. Potential negative aspects of ADR reporting, such as “disrupting the normal workflow” and “time consuming to report”, were considered less likely. Students mentioned important items needed for a qualitatively good report more often and had higher scores for basic pharmacovigilance knowledge than in an earlier study [12].

Most earlier interventions to raise awareness of ADR reporting predominantly targeted health professionals and were passive (reminders, lectures etc.) instead of active educational interventions [15]. Furthermore, the main outcomes used consisted of the number of spontaneous reports, which is an intermediate outcome, because it does not consider the additional value of the reports for pharmacovigilance (quality, novelty etc.). Interventions for
pharmacy students used lectures or other theoretical means and not contemporary educational interventions [16]. The current study was based on the conceptual framework of “learning by doing” [20] and incorporated educational theory to improve pharmacovigilance teaching and practice and measured relevant and direct outcomes. The strength of this study lies in the unique collaboration with the Netherlands Pharmacovigilance Centre Lareb, whereby real and legitimate ADRs could be assessed and used for educational purposes while contributing to the monitoring of real ADRs. The use of previously published questionnaires [12, 13, 23, 24] on ADR reporting allowed us to compare the intentions, attitudes, knowledge, and ADR handling capability of future health professionals. The use of pre- and post-participation questionnaires enabled us to investigate educational values and to monitor student progress in this longitudinal study design.

Major limitations of this study are the relatively small heterogeneous sample size (43 students) and the response rate (67.5%) for the questionnaires, both of which limited study power. Furthermore, self-selection bias played a role, since only students who had voluntarily participated in the LC-SRC were eligible to participate in the pharmacovigilance programme. Students that participated were probably more interested in the topic, having a greater interest in pharmacotherapy. Thus we may have gained an over-positive impression of the general medical student population. The concept of the student-run pharmacovigilance programme and the presented results would be of interest to other universities and to other countries where pharmacovigilance centres play a similar role as in the Netherlands. As a WHO-collaborating centre in pharmacovigilance education, Lareb plays an important role in developing, testing, distributing, and sharing innovative and successful educational methods [29].

CONCLUSION

Undergraduate medical students can make high-quality (useful, scientifically substantiated, accurate, and complete) assessments of ADR reports, and that making such assessments increases the pharmacovigilance awareness of students. Thus an student-run pharmacovigilance programme is feasible and a win–win venture for Lareb and medical students. This study contributed to insight into the intentions, skills, and knowledge of pharmacovigilance and ADRs of undergraduate medical students by providing a unique opportunity to participate in real pharmacovigilance practice. This study also showed that students valued the extra attention paid to pharmacovigilance and would prefer to have more real-life practice in their medical curriculum. Further research is needed to determine the additional value of this novel approach compared to, for instance, an ADR reporting assignment [30] or a lecture, on students’ pharmacovigilance skills. Future research should also focus on the long-term effects of innovative pharmacovigilance projects on ADR reporting.

DECLARATIONS

Acknowledgments: The authors want to thank, Mrs. D.W.M. Pijnenburg (pharmacist at the Netherlands Pharmacovigilance Centre Lareb, for her help in rating the student assessments; J.J. Sikkens MSc. (Department of Internal medicine, section pharmacotherapy, VU University Medical Center Amsterdam, the Netherlands, for his help with the statistical analysis); Mrs. S. Groenland, Mrs. S. de Boer and Mrs. L. van Gastel (VUmc school of medical sciences, Amsterdam, the Netherlands, student-run pharmacovigilance programme and SRC coordinators), All previous contributors to the LC-SRC project in VUmc, and all students participating in the student-run Pharmacovigilance program.

Funding: No sources of funding were used to assist in the preparation of this study.

Conflicts of Interest: Tim Schutte, Jelle Tichelaar, Michael O. Reumerman, Rike van Eekeren, Leàn Rolfes, Eugène P. van Puijenbroek, Milan C. Richir, and Michiel A. van Agtmael have no conflicts of interest that are directly relevant to the content of this study.

Ethical approval: The institutional review board of the VU University Medical Center reviewed the research protocol and concluded that the study did not fall under the scope of the Dutch Medical Research Involving Human Subjects Act (WMO) (reference: 15348).
REFERENCES


