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Improving community pharmacists' clinical knowledge to detect and resolve drug-related problems in Croatia: a before/after survey study investigating the impact of an educational intervention

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2019-034674
Article Type:	Original research
Date Submitted by the Author:	01-Oct-2019
Complete List of Authors:	Zekan, Lovre; Split-Dalmatia County Pharmacy; University of Split School of Medicine, Department of Pharmacy Mestrovic, Arijana; University of Split School of Medicine, Department of Pharmacy; Pharmaexpert LLC Perisin, Ana; University of Split School of Medicine, Department of Pharmacy Bukic, Josipa; University of Split School of Medicine, Department of Pharmacy Leskur, Dario; University of Split School of Medicine, Department of Pharmacy Rusic, Doris; University of Split School of Medicine, Department of Pharmacy Modun, Darko; University of Split School of Medicine, Department of Pharmacy
Keywords:	EDUCATION & TRAINING (see Medical Education & Training), THERAPEUTICS, PRIMARY CARE

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3 **1 Improving community pharmacists' clinical knowledge to detect and resolve**
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6 **2 drug-related problems in Croatia: a before/after survey study investigating**
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9 **3 the impact of an educational intervention**
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12 **4**

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49 **Word count: 2702**
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Abstract

Objectives: Drug-related problems (DRPs) represent a public health problem, both in terms of patient outcomes and healthcare expenditures. In order to prevent and resolve these problems, pharmacists should also have adequate clinical knowledge. However, since majority of today's practicing community pharmacists in Croatia did not attend courses on clinical pharmacy and pharmacotherapy, there seems to be a lack of clinical knowledge about DRPs.

Design: Before/after survey study.

Setting: University of Split School of Medicine.

Participants: 115 community pharmacists from all over the Croatia.

Interventions: An interactive three-day clinical pharmacy workshop with the goal of increasing the knowledge level of community pharmacists in Croatia to identify and resolve DRPs in routine practice. Teaching methods were based on interactive clinical case solving.

Outcome measure: Pre- and post-workshop survey-based clinical knowledge measurement tool was used in order to evaluate the effectiveness of the workshop. The lowest possible total score was 0 and the highest was 80. A higher survey score indicates a higher level of clinical knowledge to identify and resolve DRPs.

Results: Participating pharmacists had significantly higher post-workshop mean survey score than the pre-workshop mean survey score (mean 6.2; 95% CI: 4.3 to 8.1). Furthermore, it was found that community pharmacists significantly increased their survey scores, regardless of their age. **Conclusions:** Interactive and case-based clinical pharmacy workshop could be a valuable tool to increase the knowledge of community pharmacists about identification and management of DRPs in routine practice, especially if there is a lack of previous training or education.

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3 45 However, further studies are necessary to evaluate the long-term knowledge maintenance and the
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5 46 improvement in patients' clinical outcomes.
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11 **Article Summary**

12 **Strengths and limitations of this study**

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- This study included 115 community pharmacists from all over the country, and out of them 88 completed the survey both times (response rate 76,5%), which is about 4% of all community pharmacists in Croatia.
 - Educational intervention was interactive and case-based, and survey-based clinical knowledge measurement tool was validated previously and successfully used in Australia.
 - Follow-up evaluations are needed in order to evaluate the long-term effectiveness of the educational intervention.
 - The participation was voluntary and this could compromise the representativeness of the sample.

61 **Introduction**

62 Drug-related problems (DRPs) represent a public health problem, both in terms of patient
63 outcomes and healthcare expenditures, as they can ultimately lead to drug-related complications,
64 such as drug-related morbidity or mortality. Community pharmacists, as contributors to patient
65 care, should assess data concerning untoward effects of drugs and be well skilled to recognize
66 and prevent these drug-related complications, which result from unidentified or unresolved
67 DRPs.^{1 2} The pharmaceutical care concept, as one of the pillars of modern pharmacy services,

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3 68 assumes clinical interventions which lead to optimal health outcomes. Identification, prevention
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5 69 or resolution of DRPs improves patient's health outcomes, and therefore it should be integrated
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8 70 within pharmaceutical care.^{3,4} However, in order to identify and resolve DRPs, community
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10 71 pharmacists must have both the extensive clinical knowledge about them and the sufficient
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12 72 training to detect them. Therefore knowledge, along with clinical skills are important
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15 73 prerequisites to efficiently provide pharmaceutical care.⁵⁻⁹
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18 74 In our previous study, it was suggested that the additional education of community pharmacists
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20 75 in Croatia is associated with the higher level of clinical knowledge to detect and resolve DRPs (β
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22 76 = 0.272, $P < 0.001$).¹⁰ It was concluded that the additional education could increase the
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24
25 77 community pharmacists' knowledge level and thus probably make pharmaceutical care
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27 78 implementation more effective. Furthermore, using the same knowledge measurement tool, it
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29
30 79 was found that community pharmacists from Australia compared to the colleagues from Croatia
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32 80 seem to have a higher level of clinical knowledge to detect and resolve DRPs. This finding
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34 81 indicated a general need for the improvement in the knowledge level of community pharmacists
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36 82 in Croatia. This was not an unexpected finding, since clinical pharmacy and pharmaceutical care
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39 83 models are still in the initial stages of development in Croatia. First clinical pharmacy courses
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41 84 were introduced to the pharmacy curricula in 2004. Consequently, the majority of today's
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43 85 practicing community pharmacists did not attend courses on these disciplines as a part of their
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46 86 graduate education due to the unavailability of such courses.¹¹
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49 87 Previously, Mestrovic et al. also identified that community pharmacists in Croatia lack skills in
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51 88 the areas of monitoring drug therapy, patient consultation and the evaluation of outcomes, and
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3 89 that they believe they need to complete supplemental educational programs to be able to
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5 90 efficiently provide pharmaceutical care.¹²
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9 91 A short continuing education program could be used to fill the gap in community pharmacists'
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11 92 knowledge, and facilitate provision of advanced pharmaceutical care in a primary care setting.¹³
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13 93 Also, such an intervention could consequently lead to a reduced number of DRPs, presumably
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15 94 improve patients' health outcomes and reduce healthcare expenditures.
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19 95 Hence, we planned an educational intervention with the goal of improving the clinical
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21 96 knowledge level of community pharmacists in Croatia. Highly interactive and multifaceted
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23 97 learning methods, such as workshops are reported to be highly effective strategies to improve
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25 98 knowledge, professional practice and healthcare outcomes.¹⁴⁻¹⁷ Furthermore, continuing
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27 99 education programs in the form of an educational workshop have shown to improve community
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29 100 pharmacists' knowledge and clinical skills in practice.^{5 11 13 18 19} Accordingly, an interactive
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31 101 educational workshop should be an effective short-term strategy to fill the gap in community
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33 102 pharmacists' knowledge about DRPs.
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38 39 **Methods**

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41 104 A three-day clinical pharmacy workshop for community pharmacists in Croatia was organized.
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43 105 Workshop was advertised nationwide, with the help of Croatian Chamber of Pharmacists and
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45 106 Croatian Pharmaceutical Society. Participation was voluntary and community pharmacists from
46
47 107 all over Croatia participated. The workshop lasted for a total of 20 hours, and during that time
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49 108 various topics in the area of clinical pharmacy and pharmacotherapy were discussed. Included
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51 109 topics were pharmaceutical care in practice, DRPs, routine laboratory tests, food and drug
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53 110 interactions, pharmacokinetic and pharmacodynamic interactions, hormone therapy,
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3 111 dyslipidemia and diabetes, antimicrobial drugs, psychotropic drugs and antidepressants,
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5 112 hypertension and anticoagulants, narrow therapeutic index drugs, rare diseases, medication errors
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8 113 and evidence-based medicine.
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11 114 A pharmacist and a pharmacologist, both highly qualified and experienced in their respective
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13 115 fields, prepared and presented workshop materials and discussions. Key elements of an effective
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15 116 educational activity, like formal lectures and interactive clinical case solving and exercises, were
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18 117 incorporated into the program. The workshop was designed to provide a brief overview about
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20 118 each topic, but then clinical cases were solved and discussed for the most of the workshop time.
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23 119 Cases were prepared according to the clinical case models available in the literature.^{20 21} By
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25 120 lifting the letter card, each participant had to answer for which of the 4 statements in each case
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27 121 he thinks is the most correct. After all participants had revealed their answers, discussion on each
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29 122 statement followed. Participants were also invited to present a few of their own cases from
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31 123 routine practice. From 150 clinical cases, one of the most important learning objectives was
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33 124 increasing the knowledge through the identification and resolution of DRPs in the presented
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35 125 cases.
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40 126 In order to assess the level of the clinical knowledge of participating community pharmacists
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42 127 pre- and post-workshop, we used a validated survey-based clinical knowledge measurement tool
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44 128 developed by Williams et al.²² The survey was structured on nine clinical cases with a total of 40
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46 129 statements. Clinical cases were based on scenarios that were found to occur frequently in
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48 130 community pharmacies in Australia. Each clinical case was supposed to assess a pharmacist's
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50 131 ability to identify, resolve and evaluate a DRP. The survey was composed in a manner that all
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52 132 participants were asked to read short case scenarios and select how relevant, likely or appropriate
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3 133 they found each of the proposed statements using a seven-point Likert scale. In the first three
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5 134 clinical cases each statement was about additional information that would be relevant to acquire
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8 135 for that case, while the next three cases consisted of statements which described potential DRPs
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10 136 in each case and the final three cases consisted of statements about possible recommendations for
11
12 137 the patients. Furthermore, the same tool was used in a cross-sectional study with the aim of
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14 138 determining the clinical knowledge level of community pharmacists in Croatia to identify,
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17 139 evaluate and resolve DRPs, as it was previously reported.¹⁰
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20 140 All participating community pharmacists were invited on-site to independently complete the
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22 141 survey twice: at the beginning of the workshop and three days later at the end of the last session
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24 142 of the workshop. Participating pharmacists were supervised to complete the survey
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27 143 independently and without access to additional resources or literature. The survey was
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29 144 anonymous, providing only the participant's age, gender and a simple code to match the
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31 145 participants' results before and after the workshop. Study size calculation was not applicable
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33 146 because survey score difference which is associated with significant changes in routine practice
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36 147 is still not known. Therefore, all participating pharmacists were included in this study, except
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38 148 pharmacists who participated in the previous nationwide cross-sectional study, which was the
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40 149 only exclusion criteria.¹⁰
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44 150 Afterwards, all data were collected in a Microsoft Excel® worksheet (version 15, Redmond,
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46 151 WA, USA) and each completed survey was evaluated and scored. All statements were scored
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48 152 individually and each statement received a score of 2, 1 or 0 depending how far away the answer
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50 153 was from the correct answer. The lowest possible total score was 0 and the maximum possible
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3 154 80. A higher score indicates a higher level of clinical knowledge to detect, evaluate and resolve
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5 155 DRPs, as previously described.²²
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9 156 Statistical calculations and analyses of the data were performed using the IBM SPSS ® statistical
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11 157 package (version 20, Armonk, NY, USA). The graphical figure was prepared with the GraphPad
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13 158 Prism software (version 6, La Jolla, CA, USA). Mean scores of the study participants were
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15 159 analyzed with the independent samples and paired samples *t*-test. Normality of data was checked
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17 160 with the Kolmogorov-Smirnov and the Shapiro-Wilk tests. Pearson's correlation was used to
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19 161 correlate pharmacist's score with age. For all tests, a $P < 0.05$ was considered to be statistically
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21 162 significant. All values are presented as mean \pm SD.
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26 163 Primary research outcome was the change of the community pharmacists' knowledge based on
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28 164 pre- and post-workshop evaluation. In addition, age and gender subgroup analysis was
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30 165 performed. This study was approved by the University of Split School of Medicine Ethics
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32 166 Committee (003-08/15-03/0001) and each participant consented verbally to participate in the
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34 167 study, as approved by the Ethics Committee. Verbal consent was considered to be appropriate
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36 168 because of the favorable risk/benefit ratio for the participants. The intervention was educational
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38 169 and the assessment tool was the written survey so there were no particular risks for the study
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40 170 participants.
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45 171 Patient and public involvement

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49 172 No patients were involved in the design, recruitment and conduct of the study. The study
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51 173 participants voluntarily accepted to participate in this study, and they were familiarized with all
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53 174 the risks and benefits. They accepted the possibility that results of the study could be published.
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175 Results

176 Totally, 115 community pharmacists attended the workshop, and out of them, 88 completed the
 177 survey both times. This represents about 4% of all community pharmacists in Croatia.²³ The
 178 response rate, as shown in Table 1, was satisfactory because participation was voluntary and
 179 some participants dropped out before the end of the workshop. Matching method with the simple
 180 code was effective, which resulted in the successful matching of study participants for further
 181 data extraction and evaluation.

182 Table 1. Demographics of the matched study participants

	Community pharmacists
Age (mean \pm SD)	36.6 \pm 9.2
Female (%)	90.9
Male (%)	9.1
Response rate (%)	76.5

183 Participating pharmacists had a pre-workshop mean score of 42.9 ± 8.2 , and post-workshop
 184 mean score of 49.1 ± 8.0 , as presented in Fig 1. The mean score difference of 6.2 ± 9.0 , which
 185 represents a 14.5% relative increase, was found to be significant with the paired samples *t*-test
 186 ($t(87) = 6.488, P < 0.001$).

187 Fig 1. Pre- and post- workshop survey scores of participating community pharmacists by age and
 188 gender subgroups

189 (Figure 1)

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3 190 Furthermore, male pharmacists had a pre-workshop mean score of 42.6 ± 4.2 , while female
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5 191 pharmacists had a pre-workshop mean score of 42.9 ± 8.5 , with no significant difference
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8 192 between the scores with the independent samples *t*-test ($t(86) = -0.09, P = 0.93$). However, after
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10 193 the workshop only female pharmacists significantly increased their mean score (paired samples *t*-
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12 194 test, $t(79) = 6.744, P < 0.001$), with the mean score difference of 6.9 ± 9.1 .

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16 195 Pharmacists in both age subgroups significantly increased their mean scores after the workshop
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18 196 (paired samples *t*-test, $t(47) = 4.786, t(39) = 4.342, P < 0.001$) with nearly the same
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20 197 improvement, as presented in Fig 1. Interestingly, there was no significant difference in the
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23 198 survey scores between age subgroups and we found no correlation between pharmacists' survey
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25 199 scores and their age (Pearson's $r = 0.009, n = 88, P = 0.933$).

28 29 200 **Discussion**

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31 201 The intensive three-day educational workshop on clinical pharmacy seemed to significantly
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33 202 increase the clinical knowledge of community pharmacists in Croatia to detect and resolve
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36 203 DRPs. This finding implies that a short and intensive case-based educational intervention could
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38 204 potentially fill the gap in community pharmacists' knowledge about DRPs.

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42 205 To evaluate the true relevance of these findings for community pharmacy practice, it is still
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44 206 necessary to find out if the increased clinical knowledge level of community pharmacists will
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46 207 result in an increased level of clinical interventions about DRPs in daily practice. For example,
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49 208 one of the clear indicators would be the number of reported adverse drug reactions or
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51 209 documented clinical interventions in this group of pharmacists. If confirmed, these findings
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53 210 could have an important implication for pharmacists' continuing education about DRPs.

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3 211 From similar studies, Currie et al. proved that the intensive educational program in
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5 212 pharmaceutical care skills and implementation of these skills in practice successfully increased
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7 213 the rate of identified DRPs.²⁴ Kimberlin et al. reported that pharmacists who engaged in an
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9 214 educational intervention program more likely assessed DRPs than pharmacists without the
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11 215 educational intervention and this difference held in the 3-month follow-up period.²⁵ Furthermore,
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13 216 recently Lalonde et al. demonstrated that having provided community pharmacists with a short
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15 217 disease-specific training and essential clinical information successfully increased pharmacists'
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17 218 knowledge and clinical skills as well as reduced DRP frequency in community pharmacy
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19 219 practice.²⁶

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25 220 Interestingly, this study also implies that community pharmacists' age does not correlate with
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27 221 their clinical knowledge of detecting and resolving DRPs, while Mestrovic et al. study in the
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29 222 community pharmacy setting in Croatia revealed that the age of participants, presumably through
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31 223 experience, improved competency for recognizing and identifying DRPs.¹¹ However, the two
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33 224 studies used different tools to assess the pharmacist's ability to manage DRPs, and one study
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35 225 primarily evaluated knowledge while the other study evaluated competency, which further
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37 226 involves skills and attitudes of participants. This could be the reason for the different findings
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39 227 between the studies, but further research is required in order to clarify this difference.
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44 228 Furthermore, it was found that after the workshop only female pharmacists significantly
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46 229 improved their clinical knowledge about DRPs, while male pharmacists retained the same level
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48 230 of knowledge as before the workshop. This potentially could be due to a greater emphasis on
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50 231 pharmaceutical care which as a topic could be more appealing to female pharmacists.²⁷ However,
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3 232 this finding is questionable due to a small number of male participants (n = 8) and should be
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5 233 further investigated.
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9 234 A major limitation of this study is the fact that post-workshop clinical knowledge scores were
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11 235 evaluated only immediately after the workshop, so these results actually represent short term
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13 236 knowledge gain and are therefore not reflective of any sustained improvement in knowledge.
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15 237 However, patient benefits must be continuous and not limited to certain periods of time. As
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17 238 expected, a majority of studies have also confirmed that training programs increase the
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19 239 knowledge of pharmacists immediately after the educational intervention, and only a few studies
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21 240 revealed that these improvements could be maintained for a year or even longer without any
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23 241 further education.^{7 26} Therefore, follow-up evaluations are needed and these results should be
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25 242 supported by conducting a future survey to determine whether improvements were maintained
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27 243 and to further evaluate the effectiveness of the educational intervention.²⁸
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33 244 Another limitation is the possibility of overestimating the results to the general community
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35 245 pharmacist population since the workshop participation was only voluntary. It is therefore
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37 246 possible that only more motivated and enthusiastic pharmacists attended and thus had a greater
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39 247 improvement in knowledge. However, since study participants were from all over the country
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41 248 and represent both the small privately-owned pharmacies and the large pharmacy chains and
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43 249 participants gender distribution is representative of Croatian community pharmacists population,
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45 250 generalization of these results to the community pharmacy setting is much more applicable.²³
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50 251 Finally, this study once more confirms previously reported findings that educational
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52 252 interventions through short workshops are a useful tool to successfully improve pharmacists'
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54 253 knowledge on various topics in pharmacy practice.^{7 18 29 30} Educational interventions can play a
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3 254 vital role in expanding basic pharmacy education and enhancing pharmaceutical care
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5 255 implementation, especially when insufficient training has been received during undergraduate or
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8 256 graduate studies.²³
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10 11 257 **Conclusions**

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14 258 The short interactive and intensive educational intervention through the three-day clinical
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16 259 pharmacy workshop seems to improve the community pharmacists' knowledge to identify,
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18 260 evaluate and resolve DRPs in a simulated routine practice setting. Therefore, short educational
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20 261 interventions could be a valuable tool to fill the gap in pharmacist's knowledge about DRP
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22 262 management, especially if there is a lack of previous training or education. Further studies are
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24 263 necessary in order to evaluate long-term knowledge maintenance and the impact of these
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26 264 findings in community pharmacy practice.
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31 265 **Acknowledgements**

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36 266 The authors are grateful to all participating community pharmacists for making this study
37
38 267 possible and to Shelly Pranic for proofreading this paper.
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42 268 **Competing Interests**

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46 269 Lovre Zekan is employed by Split-Dalmatia County Pharmacy and Arijana Mestrovic is
47
48 270 employed by Pharmaexpert LLC. The authors further declare that they have no competing
49
50 271 interests.
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54 272 **Funding**

273 This research received no specific grant from any funding agency in the public, commercial or
274 not-for-profit sectors.

275 Author Contributions

276 DM was the leader of this research. LZ interpreted and analyzed the study data. LZ, AM and DM
277 participated in the workshop preparation. ASP, JB, DL and DR participated in conducting the
278 survey. All authors participated in preparation and approved the final manuscript.

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For peer review only

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7 360 All values are presented as mean \pm SD. Statistically significant differences between pre- and post-workshop scores
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9 361 are marked with a * symbol (paired samples t-test, $P < 0.001$). Median age of the study participants is 36 years. The
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For peer review only

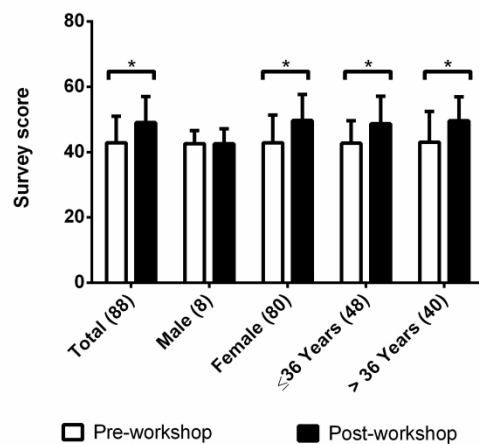


Fig 1. Pre- and post- workshop survey scores of participating community pharmacists by age and gender subgroups

All values are presented as mean \pm SD. Statistically significant differences between pre- and post-workshop scores are marked with a * symbol (paired samples t-test, $P < 0.001$). Median age of the study participants is 36 years. The number of participants in each subgroup is specified in parentheses ().

283x161mm (300 x 300 DPI)

Clinical knowledge measurement tool about drug-related problems

Gender: (M) Male (F) Female Age (years): _____ Code: _____

Instructions: Clinical cases 1 – 3.
 For each of the proposed statements, please indicate how relevant it is for each clinical case, by circling the appropriate number on 7-point scale (higher number indicates greater relevance).

Clinical case 1

A slightly overweight, 51-year-old female patient who regularly visits your pharmacy presents a prescription for perindopril 5 mg. The dispensing records indicate that the last antihypertensive agent prescribed for this patient was the perindopril/indapamide combination and it was last dispensed 3 months ago. Please indicate how relevant each piece of additional information would be in this case.

	Totally irrelevant	Moderately irrelevant	Only slightly irrelevant	Neutral	Only slightly relevant	Moderately relevant	Very relevant
1. Discuss with the patient whether the medication change was intentional.	1	2	3	4	5	6	7
2. Discuss with the patient's doctor whether the medication change was intentional.	1	2	3	4	5	6	7
3. Discuss with the patient their compliance with the antihypertensive agent.	1	2	3	4	5	6	7

Clinical case 2

A frail 80-year-old male patient presents to collect his last repeat from his glyceryl trinitrate (GTN) sublingual spray prescription. On dispensing, the pharmacist notices that this is the third time this medication has been dispensed in the last 2 weeks. Please indicate how relevant each piece of additional information would be in this case.

	Totally irrelevant	Moderately irrelevant	Only slightly irrelevant	Neutral	Only slightly relevant	Moderately relevant	Very relevant
4. Determine if the pain the patient is feeling is actually due to angina.	1	2	3	4	5	6	7
5. Ask the patient to demonstrate his administration technique.	1	2	3	4	5	6	7
6. Determine how long since the patient's general practitioner has reviewed his angina treatment.	1	2	3	4	5	6	7
7. Determine how efficacious the GTN spray is.	1	2	3	4	5	6	7

Clinical case 3

A 58 kg, 35-year-old woman presents to the pharmacy to collect a prescription for methotrexate 10 mg weekly from her rheumatologist, which is a new medication for her. Please indicate how relevant each piece of additional information would be in this case.

	Totally irrelevant	Moderately irrelevant	Only slightly irrelevant	Neutral	Only slightly relevant	Moderately relevant	Very relevant
8. Determine if the patient has had baseline liver function tests.	1	2	3	4	5	6	7
9. Determine if the patient has had a negative pregnancy test and is currently taking/using adequate contraception.	1	2	3	4	5	6	7
10. Determine if the side effects of methotrexate have been explained to the patient.	1	2	3	4	5	6	7
11. Determine if the patient has been instructed to take folic acid.	1	2	3	4	5	6	7
12. Determine how often the patient drinks alcohol.	1	2	3	4	5	6	7

Instructions: Clinical cases 4 – 6.

For each of the proposed statements, please indicate how likely it is for each clinical case, by circling the appropriate number on 7-point scale (higher number indicates higher likelihood).

Clinical case 4

A 65 kg, 45-year-old female patient comes into the pharmacy to enquire about possible side effects. She was commenced on paroxetine 20 mg daily a few days ago and has been experiencing increasing anxiety (which is the reason the paroxetine was initially started), sweating and tachycardia. She has a medical history of atrial fibrillation and severe lower back pain, and is also taking digoxin, ramipril, tramadol and methadone. Please indicate how likely each drug-related problem would be in this case.

	Highly unlikely	Moderately unlikely	Only slightly unlikely	Neutral	Only slightly likely	Moderately likely	Highly likely
13. The commencement of the paroxetine may have resulted in an increase in anxiety for the patient.	1	2	3	4	5	6	7
14. This dose of paroxetine is unlikely to be controlling the patient's anxiety symptoms and an increase in her dose should be considered.	1	2	3	4	5	6	7
15. The paroxetine may have interacted with the tramadol to cause the patient's symptoms.	1	2	3	4	5	6	7
16. The paroxetine may have interacted with the digoxin to cause the patient's symptoms.	1	2	3	4	5	6	7

Clinical case 5

A slightly overweight, 78 year-old female patient with a history of hypertension and mild heart failure presents with prescription for furosemide 20 mg daily to treat her swollen ankles. She is also currently taking lercanidipine 20 mg ramipril 2.5 mg daily, plus amitriptyline 10 mg nightly for sleep. Please indicate how likely each drug-related problem would be in this case.

	Highly unlikely	Moderately unlikely	Only slightly unlikely	Neutral	Only slightly likely	Moderately likely	Highly likely
17. The patient's symptoms are likely to indicate a worsening of her heart failure.	1	2	3	4	5	6	7
18. Lercanidipine could be causing peripheral edema.	1	2	3	4	5	6	7
19. The swollen ankles may be due to an increased fluid intake resulting from hyperglycemia.	1	2	3	4	5	6	7
20. The patient may have syndrome of inappropriate antidiuretic hormone secretion which has led to swollen ankles.	1	2	3	4	5	6	7

Clinical case 6

A woman comes into the pharmacy to collect her elderly husband's prescriptions for him while he is recuperating at home. She states there is a new prescription for 'Imdur (isosorbide mononitrate) 60 mg in the morning' that was started in the hospital last week. The new medication doesn't seem to be working and her husband is still experiencing chest pain. The husband's history shows regular dispensing of pantoprazole 40 mg nightly, clopidogrel 75 mg in the morning, atorvastatin 20 mg nightly, Duride (isosorbide mononitrate) 60 mg nightly, perindopril 5 mg and tiotropium 18 µg in the morning and glyceril trinitrate spray p.r.n. Please indicate how likely each drug-related problem would be in this case.

	Highly unlikely	Moderately unlikely	Only slightly unlikely	Neutral	Only slightly likely	Moderately likely	Highly likely
21. Her husband may be experiencing a decrease in symptom control for his chronic obstructive pulmonary disease and his shortness of breath is causing the chest pain.	1	2	3	4	5	6	7
22. Her husband may be experiencing nitrate tolerance if he has continued to take the Duride brand that he was initially prescribed, as well as the Imdur from the hospital.	1	2	3	4	5	6	7
23. Her husband should have aspirin added to decrease his chest pain symptoms.	1	2	3	4	5	6	7

Instructions: Clinical cases 7 – 9.

For each of the proposed statements, please indicate how appropriate it is for each clinical case, by circling the appropriate number on 7-point scale (higher number indicates higher appropriateness).

Clinical case 7

A slightly overweight, 70-year-old male patient is currently taking warfarin (dose is 5 mg/4 mg on alternate days). He has a dental prescription for an abscess for amoxicillin 500 mg three times a day and metronidazole 400 mg three times a day. Please indicate how appropriate each recommendation would be in this case.

	Totally inappropriate	Moderately inappropriate	Only slightly inappropriate	Neutral	Only slightly appropriate	Moderately appropriate	Very appropriate
24. Cease the warfarin while taking the antibiotics.	1	2	3	4	5	6	7
25. Discuss the interaction with the patient and recommend an increase in international normalised ratio (INR) monitoring while taking the antibiotics.	1	2	3	4	5	6	7
26. Discuss the signs and symptoms of an increased INR with the patient.	1	2	3	4	5	6	7
27. Recommend ibuprofen for pain relief for the dental abscess.	1	2	3	4	5	6	7
28. Halve the warfarin dose while taking the antibiotics.	1	2	3	4	5	6	7
29. Change the warfarin to aspirin while using the antibiotics.	1	2	3	4	5	6	7

Clinical case 8

A 65 year-old female with airways disease has a recent dispensing history containing Seretide 250/25 (two puffs twice a day and Ventolin inhaler (1–2 p.r.n.). She presents a 3-monthhold prescription to the pharmacist for prednisolone 25 mg, which reads '25 mg twice a day for three days, then 12.5 mg twice a day for three days'. On further discussion, the pharmacist determines that the patient is currently experiencing a worsening of the respiratory symptoms and is unsure what dose of prednisolone she should be taking. Please indicate how appropriate each recommendation would be in this case.

	Totally inappropriate	Moderately inappropriate	Only slightly inappropriate	Neutral	Only slightly appropriate	Moderately appropriate	Very appropriate
30. Advise the patient not to take the prednisolone 25 mg at all.	1	2	3	4	5	6	7
31. Commence over-the-counter pantoprazole 20 mg daily to decrease the risk of gastrointestinal bleeds while taking the prednisolone.	1	2	3	4	5	6	7
32. Contact the patient's general practitioner and determine what prednisolone dose she should currently be taking.	1	2	3	4	5	6	7
33. Advise the patient to cease the Seretide while she is taking the prednisolone tablets.	1	2	3	4	5	6	7
34. Advise the patient to increase the use of her Ventolin inhaler in preference to using the prednisolone.	1	2	3	4	5	6	7

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60**Clinical case 9**

120 kg, 40-year-old male smoker with osteoarthritis is taking esomeprazole 40 mg daily, but currently has no gastrointestinal symptoms. The only other medication he is currently taking is regular paracetamol for his osteoarthritis pain that he buys over the counter, and his dispensing history shows ketoprofen and cephalexin dispensed several months ago. Please indicate how appropriate each recommendation would be in this case.

	Totally inappropriate	Moderately inappropriate	Only slightly inappropriate	Neutral	Only slightly appropriate	Moderately appropriate	Very appropriate
35. Recommend the patient return to the general practitioner to reduce his dose to 20 mg daily.	1	2	3	4	5	6	7
36. Recommend the patient return to the general practitioner to trial using esomeprazole on a p.r.n. basis.	1	2	3	4	5	6	7
37. Discuss a weight management programme with the patient.	1	2	3	4	5	6	7
38. Discuss smoking cessation with the patient.	1	2	3	4	5	6	7
39. Recommend the patient have his vitamin B12 levels checked.	1	2	3	4	5	6	7
40. Recommend the patient stop the regular paracetamol and change back to ketoprofen to control his osteoarthritis pain.	1	2	3	4	5	6	7

1-male
2-female

CORRE
7

CLINIC

N	PAIRING CODE	GENDER	AGE (years)		1
1	IOB	2	33		6
2	GMB	2	33		6
3	ŽJD	2	37		7
4	MPS	2	29		7
5	DOŠ	2	29		7
6	MPM	2	29		7
7	DPA	2	38		7
8	BLM	2	27		3
9	MDI	2	35		2
10	SBB	2	34		2
11	JPB	2	38		7
12	IJB	2	38		6
13	ALJV	2	29		5
14	BGV	2	39		7
15	VJM	2	35		7
16	JMB	2	34		7
17	ŽGZ	1	28		6
18	RBA	2	39		6
19	KMP	2	35		2
20	SJJ	2	54		6
21	LJKB	2	52		6
22	DRM	2	37		6
23	ADA	2	25		5
24	VMZ	1	36		6
25	ŽPS	1	33		7
26	KGI	2	28		7
27	DLR	2	52		7
28	DMM	2	53		7
29	ZPT	2	45		7
30	AGB	2	37		7
31	MKJ	2	58		7
32	CBB	2	26		6
33	LET	2	30		6
34	ASZ	2	32		6
35	MMN	2	29		7
36	SMA	2	52		5
37	IRĐ	2	53		7
38	IAI	2	41		7
39	NMN	2	28		7
40	ADL	2	46		7
41	TTL	2	36		3

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2	42	RPB	2	42	1
3	43	APV	2	41	7
4	44	BMN	2	31	6
5	45	DEM	2	27	7
6	46	VMI	2	44	4
7	47	PDZ	1	29	7
8	48	TŠI	1	30	6
9	49	GPJ	1	32	6
10	50	JJV	2	53	6
11	51	VBŽ	1	30	6
12	52	NKN	2	53	6
13	53	NBB	2	58	5
14	54	MČM	2	30	5
15	55	VSJ	2	53	7
16	56	KAM	2	39	5
17	57	JMA	2	45	7
18	58	BVZ	2	50	7
19	59	DKZ	2	27	7
20	60	MTM	2	27	7
21	61	ABK	2	32	5
22	62	AJJ	2	46	7
23	63	MMI	2	27	6
24	64	NRI	2	47	6
25	65	MŽS	2	47	4
26	66	FPD	2	30	7
27	67	MMI	2	26	7
28	68	IVB	2	27	7
29	69	IRS	2	45	7
30	70	MCN	2	45	7
31	71	ASA	2	43	7
32	72	IMM	2	41	3
33	73	RTM	2	41	7
34	74	ZŠD	1	28	6
35	75	IRJ	2	32	7
36	76	SVR	2	26	7
37	77	ALJA	2	32	5
38	78	KNS	2	24	7
39	79	ISM	2	24	6
40	80	MRM	2	25	7
41	81	SPD	2	39	6
42	82	MBS	2	32	7
43	83	IVD	2	25	7
44	84	JKB	2	27	6
45	85	MSR	2	37	5
46	86	PMV	2	44	5
47	87	NCV	2	38	6
48	88	IDZ	2	24	6
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ACT ANSWERS:

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ALL CASES - PARTICIPANTS' ANSWERS (PRE-WORKSHOP)

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17	6	2	6	7	6	4	5	7	2
18	4	7	7	7	7	7	7	7	7
19	5	5	7	7	7	7	7	7	7
20	7	7	7	7	7	6	7	7	7
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38	5	4	6	6	6	6	6	5	5
39	6	7	7	7	7	7	7	7	7
40	6	7	7	7	7	7	7	7	7
41	4	7	3	7	5	4	6	7	7
42	6	6	6	6	7	6	6	7	4
43	6	7	7	6	7	6	6	7	6
44	6	7	7	6	7	6	6	7	6
45	7	5	7	7	7	1	4	7	7
46	7	7	7	6	7	7	6	6	6
47	7	7	7	7	7	7	7	7	7
48	4	7	6	7	7	1	6	7	5
49	3	6	7	7	7	1	5	7	6
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46	6	7	7	7	7	7	5	7	7
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58									
59									
60									

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SCORING (2 - CORRECT ANSWER, 1 - AL

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7								
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12								
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47								
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52								
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56	7	1	1	1	2	2	2	2
57								
58								
59								
60								

ADJACENT ANSWER; 0 - ALL OTHER ANSWERS)

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8	2	0	2	2	2	2	1	1	0
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11	2	0	0	2	1	1	2	1	0
12	2	0	0	2	2	1	2	2	0
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SURVEY SCORE (PRE)

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AL CASES - PARTICIPANTS' ANSWERS (POST-WORKSHOP)

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ADJACENT ANSWER; 0 - ALL OTHER ANSWERS)

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SURVEY SCORE (POST)

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8	2	0	0	44
9	1	2	2	46
10	1	1	2	49
11	1	0	0	40
12	2	1	1	48
13	1	0	2	60
14	1	2	2	39
15	2	1	0	50
16	1	0	2	40
17	1	0	0	39
18	1	1	0	58
19	1	2	0	44
20	1	2	2	45
21	2	0	1	54
22	1	0	2	53
23	2	2	0	42
24	1	2	0	43
25	1	0	1	58
26	1	2	0	48
27	1	1	0	47
28	1	1	0	50
29	1	0	0	56
30	1	2	2	66
31	1	0	1	61
32	1	0	0	57
33	1	0	0	44
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35	2	0	0	55
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37	1	2	0	58
38	1	0	0	57
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40	1	0	0	61
41	2	0	0	46
42	1	0	0	59
43	1	2	0	45
44	1	0	0	46
45	1	2	0	49
46	1	2	0	53
47	1	2	0	51
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BMJ Open

Improving community pharmacists' clinical knowledge to detect and resolve drug-related problems in Croatia: a before/after survey study investigating the effectiveness of an educational intervention

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2019-034674.R1
Article Type:	Original research
Date Submitted by the Author:	26-Dec-2019
Complete List of Authors:	Zekan, Lovre; Split-Dalmatia County Pharmacy; University of Split School of Medicine, Department of Pharmacy Mestrovic, Arijana; University of Split School of Medicine, Department of Pharmacy; Pharmaexpert LLC Perisin, Ana; University of Split School of Medicine, Department of Pharmacy Bukic, Josipa; University of Split School of Medicine, Department of Pharmacy Leskur, Dario; University of Split School of Medicine, Department of Pharmacy Rusic, Doris; University of Split School of Medicine, Department of Pharmacy Modun, Darko; University of Split School of Medicine, Department of Pharmacy
Primary Subject Heading:	Medical education and training
Secondary Subject Heading:	Public health, General practice / Family practice, Pharmacology and therapeutics
Keywords:	EDUCATION & TRAINING (see Medical Education & Training), THERAPEUTICS, PRIMARY CARE

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3 **1 Improving community pharmacists' clinical knowledge to detect and resolve**
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6 **2 drug-related problems in Croatia: a before/after survey study investigating**
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8 **3 the effectiveness of an educational intervention**
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12 **4**

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50 **21 Word count: 3419**
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Abstract

Objectives: The aim of this study was to increase the knowledge level of community pharmacists in Croatia to identify and resolve drug-related problems (DRPs).

Design: Before/after survey study.

Setting: University of Split School of Medicine.

Participants: 115 community pharmacists from all over the Croatia.

Interventions: An interactive three-day clinical pharmacy workshop with the goal of increasing the knowledge level of community pharmacists in Croatia to identify and resolve DRPs in routine practice. Teaching methods were based on interactive clinical case solving.

Outcome measure: Change of the community pharmacists' knowledge based on pre- and post-workshop evaluation. Survey-based clinical knowledge measurement tool was used in order to evaluate the effectiveness of the workshop. The lowest possible total score was 0 and the highest was 80. A higher survey score indicates a higher level of clinical knowledge to identify and resolve DRPs.

Results: Participating pharmacists had significantly higher post-workshop mean survey score (49.1 ± 8.0) than the pre-workshop mean survey score (42.9 ± 8.2), with the mean score difference of 6.2 (95% CI: 4.3 to 8.1). Furthermore, it was found that community pharmacists significantly increased their survey scores, regardless of their age.

Conclusions: Interactive and case-based clinical pharmacy workshop could be a valuable tool to increase the knowledge of community pharmacists about identification and management of DRPs in routine practice. However, further studies are necessary to evaluate the long-term knowledge maintenance and the improvement in patients' clinical outcomes.

46 **Article Summary**

47 **Strengths and limitations of this study**

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49 • This study included 115 community pharmacists from all over the country, and out of
50 them 88 completed the survey both times (response rate 76,5%), which is about 4% of all
51 community pharmacists in Croatia.

52 • Educational intervention was interactive and case-based, and survey-based clinical
53 knowledge measurement tool was validated previously and successfully used in
54 Australia.

55 • Follow-up evaluations are needed in order to evaluate the long-term effectiveness of the
56 educational intervention.

57 • The participation was voluntary and this could compromise the representativeness of the
58 sample.

59 **Introduction**

60 Drug-related problems (DRPs) represent a public health problem, both in terms of patient
61 outcomes and healthcare expenditures, as they can ultimately lead to drug-related complications,
62 such as drug-related morbidity or mortality. Community pharmacists, as contributors to patient
63 care, should assess data concerning untoward effects of drugs and be well skilled to recognize
64 and prevent these drug-related complications, which result from unidentified or unresolved
65 DRPs.^{1 2} The pharmaceutical care concept, as one of the pillars of modern pharmacy services,
66 assumes clinical interventions which lead to optimal health outcomes. Identification, prevention
67 or resolution of DRPs improves patient's health outcomes, and therefore it should be integrated
68 within pharmaceutical care.^{3 4} However, community pharmacists must have the extensive clinical

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3 69 knowledge and the sufficient training in order to identify and resolve DRPs. Therefore,
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5 70 knowledge and training are important prerequisites to efficiently provide pharmaceutical care.⁵⁻⁹
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9 71 In our previous study, it was suggested that the additional education of community pharmacists
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11 72 in Croatia is associated with the higher level of clinical knowledge to detect and resolve DRPs (β
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13 73 = 0.272, $P < 0.001$).¹⁰ It was concluded that the additional education could increase the
14
15 74 community pharmacists' knowledge level and thus probably make pharmaceutical care
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17 75 implementation more effective. Furthermore, using the same knowledge measurement tool, it
18
19 76 was found that community pharmacists from Australia compared to the colleagues from Croatia
20
21 77 seem to have a higher level of clinical knowledge to detect and resolve DRPs.¹¹ This finding
22
23 78 indicated a general need for the improvement in the knowledge level of community pharmacists
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25 79 in Croatia. This was not an unexpected finding, since clinical pharmacy and pharmaceutical care
26
27 80 models are still in the initial stages of development in Croatia. Firstly, Centre for Applied
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29 81 Pharmacy was established at the University of Zagreb Faculty of Pharmacy and Biochemistry in
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31 82 2004. Afterwards, clinical pharmacy was the first subject to be introduced to the revised
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33 83 pharmacy curricula. Patient-oriented subjects such as pharmacotherapy, communication skills,
34
35 84 pharmacy practice and pharmaceutical care were introduced between 2006 and 2009.¹² At that
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37 85 time, University of Zagreb Faculty of Pharmacy and Biochemistry was the only faculty for
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39 86 education of pharmacists in Croatia. Consequently, the majority of today's practicing community
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41 87 pharmacists did not attend courses on these disciplines as a part of their graduate education due
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43 88 to the unavailability of such courses. Furthermore, the most of available education for licensed
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45 89 community pharmacists was aimed at promoting the products and consequently was without
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47 90 significant benefits to pharmacists' knowledge about DRPs.

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3 91 Previously, Mestrovic et al. also identified that community pharmacists in Croatia lack skills in
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5 92 the areas of monitoring drug therapy, patient consultation and the evaluation of outcomes, and
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7 93 that they believe they need to complete supplemental educational programs to be able to
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10 94 efficiently provide pharmaceutical care.¹³
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13 95 Therefore, there seems to be a need for an additional education programs that could fill the gap
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15 96 in community pharmacists' knowledge about DRPs, and presumably improve patients' health
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17 97 outcomes. Highly interactive and multifaceted learning methods, such as workshops are reported
18
19 98 to be highly effective strategies to improve knowledge, professional practice and healthcare
20
21 99 outcomes.¹⁴⁻¹⁷ Furthermore, continuing education programs in the form of an educational
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23 100 workshop have shown to improve community pharmacists' knowledge and clinical skills in
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25 101 practice.^{5 12 18-20} Hence, we planned an educational intervention in the form of a workshop with
26
27 102 the goal of improving the clinical knowledge level of community pharmacists in Croatia.
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32 33 103 **Methods**

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36 37 105 **Workshop setting**

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41 106 A three-day clinical pharmacy workshop for community pharmacists in Croatia was organized.
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43 107 Workshop was advertised nationwide, with the help of Croatian Chamber of Pharmacists and
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45 108 Croatian Pharmaceutical Society. Participation was voluntary and community pharmacists from
46
47 109 all over Croatia participated. The workshop lasted for a total of 20 hours, and during that time
48
49 110 various topics in the area of clinical pharmacy and pharmacotherapy were discussed, as shown in
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51 111 Table 1.
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112 Table 1. Curriculum of the workshop

Topic	Number of teaching hours	Main teaching method
Pharmaceutical care in practice	1	Formal lectures
Rational pharmacotherapy and drug-related problems	1	Formal lectures
Clinical pharmacy and evidence-based medicine	1	Formal lectures
Routine laboratory tests	1.5	Clinical case solving
Food and drug interactions	1	Clinical case solving
Pharmacokinetic and pharmacodynamic interactions	1	Clinical case solving
Hormone therapy	1.5	Clinical case solving
Psychotropic drugs and antidepressants	1.5	Clinical case solving
Antimicrobial drugs	1.5	Clinical case solving
Rare diseases	1.5	Clinical case solving
Hypertension and anticoagulants	1	Clinical case solving
Dyslipidemia and diabetes	1	Clinical case solving
Narrow therapeutic index drugs	1.5	Clinical case solving
Medication errors	2	Clinical case solving
Priority assessment in pharmacotherapy	2	Clinical case solving

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3 113 The workshop was held in a lecture hall at University of Split School of Medicine with the help
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5 114 of assistants and pharmacy students. They supervised all participants during the workshop, and
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7 115 participants who did not attend all sessions were considered to have dropped out from the study.
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10 116 A pharmacist and a pharmacologist were trainers who prepared and presented workshop
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12 117 materials and discussions. Both trainers have appropriate education and qualifications, for
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14 118 example the pharmacist is a competency development manager and lecturer of pharmaceutical
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16 119 care with a PhD and ambulatory care specialization from American College of Clinical
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18 120 Pharmacy and the pharmacologist is a professor of pharmacology and clinical pharmacy at
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20 121 University of Split School of Medicine. Furthermore, key elements of an effective educational
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22 122 activity, like formal lectures and interactive clinical case solving and exercises, were
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24 123 incorporated into the program. The workshop was designed to provide a brief overview about
25
26 124 each topic, but then clinical cases were solved and discussed for the most of the workshop time.
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29 125 Cases were prepared according to the clinical case models available in the literature.^{21 22} By
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31 126 lifting the letter card, each participant had to answer for which of the 4 statements in each case
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33 127 he thought was the most correct. After all participants had revealed their answers, discussion on
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35 128 each statement followed. Participants were also invited to present a few of their own cases from
36
37 129 routine practice. From 150 clinical cases, one of the most important learning objectives was
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39 130 increasing the knowledge through the identification and resolution of DRPs in the presented
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41 131 cases. Other learning objectives included developing skill of decision-making process in routine
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43 132 practice, priority assessment in pharmacotherapy and general introduction to the concept of
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45 133 pharmaceutical care.
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53 134 **Evaluation of the workshop effectiveness**

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3 135 In order to assess the level of the clinical knowledge of participating community pharmacists
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5 136 pre- and post-workshop, we used a validated survey-based clinical knowledge measurement tool
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7 137 developed by Williams et al.¹¹ ('supplementary file Survey') Also, the same tool was used in a
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9 138 cross-sectional study with the aim of determining the clinical knowledge level of community
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11 139 pharmacists in Croatia to identify, evaluate and resolve DRPs, as it was previously reported.¹⁰
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14 140 The survey was structured on nine clinical cases with a total of 40 statements. Clinical cases
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16 141 were based on scenarios that were found to occur frequently in community pharmacies in
17
18 142 Australia. Each clinical case was supposed to assess a pharmacist's ability to identify, resolve
19
20 143 and evaluate a DRP. The survey was composed in a manner that all participants were asked to
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22 144 read short case scenarios and select how relevant, likely or appropriate they found each of the
23
24 145 proposed statements using a seven-point Likert scale. In the first three clinical cases each
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26 146 statement was about additional information that would be relevant to acquire for that case, while
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28 147 the next three cases consisted of statements which described potential DRPs in each case and the
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30 148 final three cases consisted of statements about possible recommendations for the patients. Since
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32 149 the clinical cases were supposed to assess pharmacists' ability to manage DRPs, the type of
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34 150 knowledge that was measured is mostly procedural knowledge, as it includes decision making
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36 151 and problem solving in routine practice. However, to be able effectively perform these
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38 152 procedures in practice, pharmacists' procedural knowledge must be based on extensive
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40 153 declarative knowledge.

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42 154 All participating community pharmacists were invited on-site to independently complete the
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44 155 survey twice: at the beginning of the workshop and three days later at the end of the last session
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46 156 of the workshop. Participating pharmacists were supervised to complete the survey
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48 157 independently and without access to additional resources or literature. The survey was

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3 158 anonymous, providing only the participant's age, gender and a simple code to match the
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5 159 participants' results before and after the workshop. Study size calculation was not applicable
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7 160 because survey score difference which is associated with significant changes in routine practice
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10 161 is still not known. Therefore, all participating pharmacists were included in this study, except
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12 162 pharmacists who participated in the previous nationwide cross-sectional study, which was the
13
14 163 only exclusion criteria.¹⁰
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18 164 **Data collection and statistical analysis**

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21 165 Afterwards, all data were collected in a Microsoft Excel® worksheet (version 15, Redmond,
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23 166 WA, USA) and each completed survey was evaluated and scored. ('supplementary file Dataset')
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26 167 All statements were scored individually and each statement received a score of 2, 1 or 0
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28 168 depending how far away the answer was from the correct answer. The lowest possible total score
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30 169 was 0 and the maximum possible 80. A higher score indicates a higher level of clinical
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33 170 knowledge to detect, evaluate and resolve DRPs, as previously described.¹¹
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37 171 Statistical calculations and analyses of the data were performed using the IBM SPSS ® statistical
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39 172 package (version 20, Armonk, NY, USA). The graphical figure was prepared with the GraphPad
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41 173 Prism software (version 6, La Jolla, CA, USA). Mean scores of the study participants were
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43 174 analyzed with the independent samples and paired samples *t*-test. Normality of data was checked
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46 175 with the Kolmogorov-Smirnov and the Shapiro-Wilk tests. Pearson's correlation was used to
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48 176 correlate pharmacist's score with age. For all tests, a $P < 0.05$ was considered to be statistically
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50 177 significant. All values are presented as mean \pm SD.
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53 54 178 **Aim of the study**

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3 179 The aim of this study was to increase the knowledge level of community pharmacists in Croatia
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5 180 to identify and resolve DRPs. Primary research outcome was the change of the community
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8 181 pharmacists' knowledge based on pre- and post-workshop evaluation. In addition, age and
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10 182 gender subgroup analysis was performed.

13 183 **Ethics Committee approval**

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17 184 This study was approved by the University of Split School of Medicine Ethics Committee (003-
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19 185 08/15-03/0001) and each participant consented verbally to participate in the study, as approved
20
21 186 by the Ethics Committee. Verbal consent was considered to be appropriate because of the
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23 187 favorable risk/benefit ratio for the participants. The intervention was educational and the
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25 188 assessment tool was the written survey so there were no particular risks for the study
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27 189 participants.

31 190 **Patient and public involvement**

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35 191 No patients were involved in the design, recruitment and conduct of the study. The study
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37 192 participants voluntarily accepted to participate in this study, and they were familiarized with all
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39 193 the risks and benefits. They accepted the possibility that results of the study could be published.

42 194 **Results**

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46 195 Overall, 115 community pharmacists attended the workshop, 9 were excluded due to having
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48 196 previously completed the survey and in total 88 pharmacists completed the survey both times.
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50 197 This represents about 4% of all community pharmacists in Croatia.²³ The response rate, as shown
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52 198 in Table 2, was satisfactory because participation was voluntary and some participants dropped
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54 199 out before the end of the workshop. Matching method with the simple code was effective, which

200 resulted in the successful matching of study participants for further data extraction and
 201 evaluation.

202 Table 2. Demographics of the matched study participants

	Community pharmacists
Age (mean \pm SD)	36.6 \pm 9.2
Female (%)	90.9
Male (%)	9.1
Response rate (%)	76.5

203 Participating pharmacists had a pre-workshop mean score of 42.9 ± 8.2 , and post-workshop
 204 mean score of 49.1 ± 8.0 , as presented in Fig 1. The mean score difference of 6.2 ± 9.0 , which
 205 represents a 14.5% relative increase, was found to be significant with the paired samples *t*-test (*t*
 206 = 6.488, *P* < 0.001).

207 Fig 1. Pre- and post- workshop survey scores of participating community pharmacists by age and
 208 gender subgroups

209 (Figure 1)

210 Furthermore, male pharmacists had a pre-workshop mean score of 42.6 ± 4.2 , while female
 211 pharmacists had a pre-workshop mean score of 42.9 ± 8.5 , with no significant difference
 212 between the scores with the independent samples *t*-test (*t* = -0.09, *P* = 0.93). However, after the

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3 213 workshop only female pharmacists significantly increased their mean score (paired samples *t*-
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5 214 test, $t = 6.744$, $P < 0.001$), with the mean score difference of 6.9 ± 9.1 .
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9 215 Pharmacists in both age subgroups significantly increased their mean scores after the workshop
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11 216 (paired samples *t*-test, $t = 4.786$, $t = 4.342$, $P < 0.001$) with nearly the same improvement, as
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13 217 presented in Fig 1. Interestingly, there was no significant difference in the survey scores between
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15 218 age subgroups and we found no correlation between pharmacists' survey scores and their age
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17 219 (Pearson's $r = 0.009$, $n = 88$, $P = 0.933$).
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220 **Discussion**

221 The intensive three-day educational workshop on clinical pharmacy seemed to significantly
222 increase the clinical knowledge of community pharmacists in Croatia to detect and resolve
223 DRPs. This finding implies that an intensive case-based educational intervention could
224 potentially fill the gap in community pharmacists' knowledge about DRPs.
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226 From similar studies, Currie et al. proved that the intensive educational program in
227 pharmaceutical care skills and implementation of these skills in practice successfully increased
228 the rate of identified DRPs.²⁴ They used the 40-hour training program in two parts with the focus
229 on the improvement of problem-solving and communication skills. Their training program did
230 not include clinical pharmacy topics and was solely focused on pharmaceutical care. In addition,
231 Currie et al. evaluated the impact of an educational intervention directly on patients and found
232 that education of pharmacists in pharmaceutical care improves patient outcomes through
233 identification of DRPs. Kimberlin et al. reported that pharmacists who engaged in an educational
234 intervention program more likely assessed DRPs than pharmacists without the educational
intervention and this difference held in the 3-month follow-up period.²⁵ Their training program

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3 235 included day-long workshop and home study using a training manual. Furthermore, they
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5 236 evaluated the effectiveness of an intervention by interviewing the patients which indicates better
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7 237 outcomes in routine pharmacy practice. In contrast to this study, results of Kimberlin et al. study
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9 238 are based on elderly patients. Furthermore, recently Lalonde et al. demonstrated that having
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11 239 provided community pharmacists with a short disease-specific training and essential clinical
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13 240 information successfully increased pharmacists' knowledge and clinical skills as well as reduced
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15 241 DRP frequency in community pharmacy practice.²⁶ Lalonde et al. used short 90-minute
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17 242 interactive web based training program on use of medications in chronic kidney disease.
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19 243 Pharmacists in their study completed self-administered questionnaire 12 months later, which
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21 244 showed that pharmacists improved knowledge by 4.5% and clinical skills by 7.4%. Compared to
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23 245 this study it is a smaller relative knowledge increase, however it is maintained a year after
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25 246 educational intervention. According to the Obreli-Neto et al., the majority of continuing
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27 247 education programs were reported to be effective based on the studies' outcome measures.²⁷ It is
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29 248 therefore difficult to compare study results without standardization of outcome measures. Also,
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31 249 studies with similar duration of training and evaluation of participants reported heterogeneous
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33 250 relative knowledge increasement, that ranged from 19% to higher or even 5%, as satisfying.^{28 29}
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41 251 Interestingly, this study also implies that community pharmacists' age does not correlate with
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43 252 their clinical knowledge of detecting and resolving DRPs, while Mestrovic et al. study in the
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45 253 community pharmacy setting in Croatia revealed that the age of participants, presumably through
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47 254 experience, improved competency for recognizing and identifying DRPs.¹² However, the two
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49 255 studies used different tools to assess the pharmacist's ability to manage DRPs, and one study
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51 256 primarily evaluated knowledge while the other study evaluated competency, which further
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54 257 involves skills and attitudes of participants. Competency is the ability of pharmacist to make
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3 258 deliberate choices for handling situations and tasks in professional pharmacy practice by using
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5 259 and integrating knowledge and personal values.³⁰ Assessment of attitudes, skills and personal
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8 260 values requires more sophisticated evaluation methods, for example direct observations and
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10 261 objective structured clinical examinations. Therefore, it is possible that age of pharmacists
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12 262 through experience in practice impacts mostly skills, attitudes and personal values of community
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14 263 pharmacists. As opposed to, pharmacists' knowledge could stagnate over time, especially if it is
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17 264 not renewed with continuous educations. This could be the reason for the different findings
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19 265 between the studies, but further research is required in order to clarify this difference.
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23 266 Furthermore, it was found that after the workshop only female pharmacists significantly
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25 267 improved their clinical knowledge about DRPs, while male pharmacists retained the same level
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27 268 of knowledge as before the workshop. This potentially could be due to a greater emphasis on
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29 269 pharmaceutical care which as a topic could be more appealing to female pharmacists.³¹ However,
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31 270 it is also possible that a small number of male participants (n = 8) was not sufficient to show
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33 271 statistical significance, and therefore this finding is questionable and should be further
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35 272 investigated.
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40 273 Surprisingly, even after the workshop the overall survey scores were also lower than the scores
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42 274 from the original study in Australia.¹¹ Survey was based on clinical cases and DRPs which are
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44 275 relevant in Australian community pharmacy setting. However, the same cases with the same
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46 276 DRPs can be routinely found in Croatian community pharmacy practice, so this could not be the
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48 277 reason for such a difference. As mentioned, this most probably arises from different educational
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50 278 backgrounds and different role of community pharmacists in healthcare systems.¹⁰ Community
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52 279 pharmacists in Croatia are still mostly oriented on traditional pharmacy services like dispensing
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3 280 and supplying of medicines, while additional services, which could expand their role as health
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5 281 care providers, are not available in practice. It is only in the last few years that work has begun to
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7 282 introduce advanced services, like medication review in pharmacy practice. Furthermore, pre-
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10 283 workshop survey scores were also lower than scores in previous nationwide study.¹⁰ Given that
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12 284 the participation was voluntary, it is very likely that pharmacists who believed that they lack
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14 285 knowledge in this area have applied in greater numbers. Also, authors of the workshop expected
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16 286 this since they knew about community pharmacists' general lack of knowledge about DRPs.
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19 287 Therefore, they decided to use the same survey to evaluate the effectiveness of educational
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25 289 A major limitation of this study is the fact that post-workshop clinical knowledge scores were
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27 290 evaluated only immediately after the workshop, so these results actually represent short term
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29 291 knowledge gain and are therefore not reflective of any sustained improvement in knowledge.
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31 292 However, patient benefits must be continuous and not limited to certain periods of time. As
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33 293 expected, a majority of studies have also confirmed that training programs increase the
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35 294 knowledge of pharmacists immediately after the educational intervention, and only a few studies
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37 295 revealed that these improvements could be maintained for a year or even longer without any
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39 296 further education.^{7 26} Therefore, follow-up evaluations are needed and these results should be
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41 297 supported by conducting a future survey to determine whether improvements were maintained
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43 298 and to further evaluate the effectiveness of the educational intervention.

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49 299 Another limitation is the possibility of overestimating the results to the general community
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51 300 pharmacist population since the workshop participation was only voluntary. It is therefore
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53 301 possible that only more motivated and enthusiastic pharmacists attended and thus had a greater
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3 302 improvement in knowledge. It is also possible that any prior training of pharmacists could have
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5 303 impacted the pharmacists' knowledge, although this was the first large scale educational
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7 304 intervention with the goal of increasing knowledge about DRPs in Croatia. Since community
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10 305 pharmacists in Croatia have not previously received any training of this type and there were no
11
12 306 pharmacists who have completed postgraduate studies, this was probably not a limitation. Also,
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14 307 since study participants were from all over the country and represent both the small privately-
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16 308 owned pharmacies and the large pharmacy chains and participants gender distribution is
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19 309 representative of Croatian community pharmacists population, generalization of these results to
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21 310 the community pharmacy setting is much more applicable.²³
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25 311 Finally, this study once more confirms previously reported findings that educational
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27 312 interventions through workshops are a useful tool to successfully improve pharmacists'
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29 313 knowledge on various topics in pharmacy practice.^{7 19 32 33} Educational interventions can play a
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31 314 vital role in expanding basic pharmacy education and enhancing pharmaceutical care
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34 315 implementation, especially when insufficient training has been received during undergraduate or
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36 316 graduate studies.²³ However, to evaluate the true relevance of these findings for community
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39 317 pharmacy practice, it is still necessary to find out if the increased clinical knowledge level of
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41 318 community pharmacists will result in an increased level of clinical interventions about DRPs in
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43 319 daily practice. For example, one of the clear indicators would be the number of reported adverse
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45 320 drug reactions or documented clinical interventions in this group of pharmacists. If confirmed,
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47 321 these findings could have an important implication for pharmacists' continuing education about
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54 323 **Conclusions**

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3 324 The interactive and intensive educational intervention through the three-day clinical pharmacy
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5 325 workshop seems to improve the community pharmacists' knowledge to identify, evaluate and
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7 326 resolve DRPs in a simulated routine practice setting. Therefore, educational interventions could
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10 327 be a valuable tool to fill the gap in pharmacist's knowledge about DRP management. Further
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12 328 studies are necessary in order to evaluate long-term knowledge maintenance and the impact of
13
14 329 these findings in community pharmacy practice.

18 330 **Acknowledgements**

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23 331 The authors are grateful to all participating community pharmacists for making this study
24
25 332 possible and to Shelly Pranic for proofreading this paper.

28 333 **Competing Interests**

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31
32
33 334 Lovre Zekan is employed by Split-Dalmatia County Pharmacy and Arijana Mestrovic is
34
35 335 employed by Pharmaexpert LLC. The authors further declare that they have no competing
36
37 336 interests.

41 337 **Funding**

43
44
45
46 338 This research received no specific grant from any funding agency in the public, commercial or
47
48 339 not-for-profit sectors.

51 340 **Author Contributions**

1
2
3 341 DM was the leader of this research. LZ interpreted and analyzed the study data. LZ, AM and DM
4
5 342 participated in the workshop preparation. ASP, JB, DL and DR participated in conducting the
6
7
8 343 survey. All authors participated in preparation and approved the final manuscript.
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11 344 **Data Availability Statement**

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16 345 All data relevant to the study are included in the article or uploaded as supplementary
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18 346 information.
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For peer review only

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7 435 All values are presented as mean \pm SD. Statistically significant differences between pre- and post-workshop scores
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9 436 are marked with a * symbol (paired samples t-test, $P < 0.001$). Median age of the study participants is 36 years. The
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11 437 number of participants in each subgroup is specified in parentheses ().
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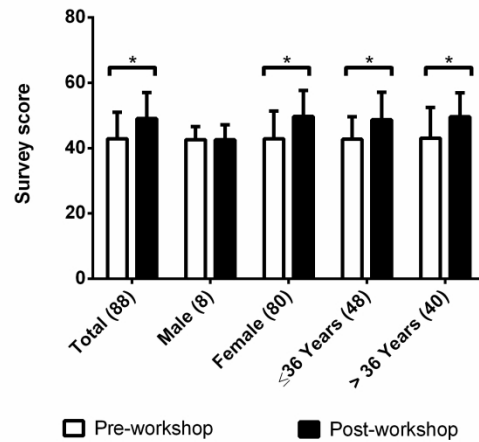


Fig 1. Pre- and post- workshop survey scores of participating community pharmacists by age and gender subgroups

All values are presented as mean \pm SD. Statistically significant differences between pre- and post-workshop scores are marked with a * symbol (paired samples t-test, $P < 0.001$). Median age of the study participants is 36 years. The number of participants in each subgroup is specified in parentheses ().

283x161mm (300 x 300 DPI)

Clinical knowledge measurement tool about drug-related problems

Gender: (M) Male (F) Female Age (years): _____ Code: _____

Instructions: Clinical cases 1 – 3.
 For each of the proposed statements, please indicate how relevant it is for each clinical case, by circling the appropriate number on 7-point scale (higher number indicates greater relevance).

Clinical case 1

A slightly overweight, 51-year-old female patient who regularly visits your pharmacy presents a prescription for perindopril 5 mg. The dispensing records indicate that the last antihypertensive agent prescribed for this patient was the perindopril/indapamide combination and it was last dispensed 3 months ago. Please indicate how relevant each piece of additional information would be in this case.

	Totally irrelevant	Moderately irrelevant	Only slightly irrelevant	Neutral	Only slightly relevant	Moderately relevant	Very relevant
1. Discuss with the patient whether the medication change was intentional.	1	2	3	4	5	6	7
2. Discuss with the patient's doctor whether the medication change was intentional.	1	2	3	4	5	6	7
3. Discuss with the patient their compliance with the antihypertensive agent.	1	2	3	4	5	6	7

Clinical case 2

A frail 80-year-old male patient presents to collect his last repeat from his glyceryl trinitrate (GTN) sublingual spray prescription. On dispensing, the pharmacist notices that this is the third time this medication has been dispensed in the last 2 weeks. Please indicate how relevant each piece of additional information would be in this case.

	Totally irrelevant	Moderately irrelevant	Only slightly irrelevant	Neutral	Only slightly relevant	Moderately relevant	Very relevant
4. Determine if the pain the patient is feeling is actually due to angina.	1	2	3	4	5	6	7
5. Ask the patient to demonstrate his administration technique.	1	2	3	4	5	6	7
6. Determine how long since the patient's general practitioner has reviewed his angina treatment.	1	2	3	4	5	6	7
7. Determine how efficacious the GTN spray is.	1	2	3	4	5	6	7

Clinical case 3

A 58 kg, 35-year-old woman presents to the pharmacy to collect a prescription for methotrexate 10 mg weekly from her rheumatologist, which is a new medication for her. Please indicate how relevant each piece of additional information would be in this case.

	Totally irrelevant	Moderately irrelevant	Only slightly irrelevant	Neutral	Only slightly relevant	Moderately relevant	Very relevant
8. Determine if the patient has had baseline liver function tests.	1	2	3	4	5	6	7
9. Determine if the patient has had a negative pregnancy test and is currently taking/using adequate contraception.	1	2	3	4	5	6	7
10. Determine if the side effects of methotrexate have been explained to the patient.	1	2	3	4	5	6	7
11. Determine if the patient has been instructed to take folic acid.	1	2	3	4	5	6	7
12. Determine how often the patient drinks alcohol.	1	2	3	4	5	6	7

Instructions: Clinical cases 4 – 6.

For each of the proposed statements, please indicate how likely it is for each clinical case, by circling the appropriate number on 7-point scale (higher number indicates higher likelihood).

Clinical case 4

A 65 kg, 45-year-old female patient comes into the pharmacy to enquire about possible side effects. She was commenced on paroxetine 20 mg daily a few days ago and has been experiencing increasing anxiety (which is the reason the paroxetine was initially started), sweating and tachycardia. She has a medical history of atrial fibrillation and severe lower back pain, and is also taking digoxin, ramipril, tramadol and methadone. Please indicate how likely each drug-related problem would be in this case.

	Highly unlikely	Moderately unlikely	Only slightly unlikely	Neutral	Only slightly likely	Moderately likely	Highly likely
13. The commencement of the paroxetine may have resulted in an increase in anxiety for the patient.	1	2	3	4	5	6	7
14. This dose of paroxetine is unlikely to be controlling the patient's anxiety symptoms and an increase in her dose should be considered.	1	2	3	4	5	6	7
15. The paroxetine may have interacted with the tramadol to cause the patient's symptoms.	1	2	3	4	5	6	7
16. The paroxetine may have interacted with the digoxin to cause the patient's symptoms.	1	2	3	4	5	6	7

Clinical case 5

A slightly overweight, 78 year-old female patient with a history of hypertension and mild heart failure presents with prescription for furosemide 20 mg daily to treat her swollen ankles. She is also currently taking lercanidipine 20 mg ramipril 2.5 mg daily, plus amitriptyline 10 mg nightly for sleep. Please indicate how likely each drug-related problem would be in this case.

	Highly unlikely	Moderately unlikely	Only slightly unlikely	Neutral	Only slightly likely	Moderately likely	Highly likely
17. The patient's symptoms are likely to indicate a worsening of her heart failure.	1	2	3	4	5	6	7
18. Lercanidipine could be causing peripheral edema.	1	2	3	4	5	6	7
19. The swollen ankles may be due to an increased fluid intake resulting from hyperglycemia.	1	2	3	4	5	6	7
20. The patient may have syndrome of inappropriate antidiuretic hormone secretion which has led to swollen ankles.	1	2	3	4	5	6	7

Clinical case 6

A woman comes into the pharmacy to collect her elderly husband's prescriptions for him while he is recuperating at home. She states there is a new prescription for 'Imdur (isosorbide mononitrate) 60 mg in the morning' that was started in the hospital last week. The new medication doesn't seem to be working and her husband is still experiencing chest pain. The husband's history shows regular dispensing of pantoprazole 40 mg nightly, clopidogrel 75 mg in the morning, atorvastatin 20 mg nightly, Duride (isosorbide mononitrate) 60 mg nightly, perindopril 5 mg and tiotropium 18 µg in the morning and glyceril trinitrate spray p.r.n. Please indicate how likely each drug-related problem would be in this case.

	Highly unlikely	Moderately unlikely	Only slightly unlikely	Neutral	Only slightly likely	Moderately likely	Highly likely
21. Her husband may be experiencing a decrease in symptom control for his chronic obstructive pulmonary disease and his shortness of breath is causing the chest pain.	1	2	3	4	5	6	7
22. Her husband may be experiencing nitrate tolerance if he has continued to take the Duride brand that he was initially prescribed, as well as the Imdur from the hospital.	1	2	3	4	5	6	7
23. Her husband should have aspirin added to decrease his chest pain symptoms.	1	2	3	4	5	6	7

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60**Instructions: Clinical cases 7 – 9.**

For each of the proposed statements, please indicate how appropriate it is for each clinical case, by circling the appropriate number on 7-point scale (higher number indicates higher appropriateness).

Clinical case 7

A slightly overweight, 70-year-old male patient is currently taking warfarin (dose is 5 mg/4 mg on alternate days). He has a dental prescription for an abscess for amoxicillin 500 mg three times a day and metronidazole 400 mg three times a day. Please indicate how appropriate each recommendation would be in this case.

	Totally inappropriate	Moderately inappropriate	Only slightly inappropriate	Neutral	Only slightly appropriate	Moderately appropriate	Very appropriate
24. Cease the warfarin while taking the antibiotics.	1	2	3	4	5	6	7
25. Discuss the interaction with the patient and recommend an increase in international normalised ratio (INR) monitoring while taking the antibiotics.	1	2	3	4	5	6	7
26. Discuss the signs and symptoms of an increased INR with the patient.	1	2	3	4	5	6	7
27. Recommend ibuprofen for pain relief for the dental abscess.	1	2	3	4	5	6	7
28. Halve the warfarin dose while taking the antibiotics.	1	2	3	4	5	6	7
29. Change the warfarin to aspirin while using the antibiotics.	1	2	3	4	5	6	7

Clinical case 8

A 65 year-old female with airways disease has a recent dispensing history containing Seretide 250/25 (two puffs twice a day and Ventolin inhaler (1–2 p.r.n.). She presents a 3-monthhold prescription to the pharmacist for prednisolone 25 mg, which reads '25 mg twice a day for three days, then 12.5 mg twice a day for three days'. On further discussion, the pharmacist determines that the patient is currently experiencing a worsening of the respiratory symptoms and is unsure what dose of prednisolone she should be taking. Please indicate how appropriate each recommendation would be in this case.

	Totally inappropriate	Moderately inappropriate	Only slightly inappropriate	Neutral	Only slightly appropriate	Moderately appropriate	Very appropriate
30. Advise the patient not to take the prednisolone 25 mg at all.	1	2	3	4	5	6	7
31. Commence over-the-counter pantoprazole 20 mg daily to decrease the risk of gastrointestinal bleeds while taking the prednisolone.	1	2	3	4	5	6	7
32. Contact the patient's general practitioner and determine what prednisolone dose she should currently be taking.	1	2	3	4	5	6	7
33. Advise the patient to cease the Seretide while she is taking the prednisolone tablets.	1	2	3	4	5	6	7
34. Advise the patient to increase the use of her Ventolin inhaler in preference to using the prednisolone.	1	2	3	4	5	6	7

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60**Clinical case 9**

120 kg, 40-year-old male smoker with osteoarthritis is taking esomeprazole 40 mg daily, but currently has no gastrointestinal symptoms. The only other medication he is currently taking is regular paracetamol for his osteoarthritis pain that he buys over the counter, and his dispensing history shows ketoprofen and cephalexin dispensed several months ago. Please indicate how appropriate each recommendation would be in this case.

	Totally inappropriate	Moderately inappropriate	Only slightly inappropriate	Neutral	Only slightly appropriate	Moderately appropriate	Very appropriate
35. Recommend the patient return to the general practitioner to reduce his dose to 20 mg daily.	1	2	3	4	5	6	7
36. Recommend the patient return to the general practitioner to trial using esomeprazole on a p.r.n. basis.	1	2	3	4	5	6	7
37. Discuss a weight management programme with the patient.	1	2	3	4	5	6	7
38. Discuss smoking cessation with the patient.	1	2	3	4	5	6	7
39. Recommend the patient have his vitamin B12 levels checked.	1	2	3	4	5	6	7
40. Recommend the patient stop the regular paracetamol and change back to ketoprofen to control his osteoarthritis pain.	1	2	3	4	5	6	7

1-male
2-female

CORRECT ANSWERS:

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CLINICAL CASES - PARTICIPANTS' ANSWERS (PRE-WORKSHOP)

N	PAIRING CODE	GENDER	AGE (years)	Answers																																										
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38					
1	IOB	2	33	6	4	7	3	4	7	6	4	7	7	7	7	7	5	14	3	6	6	7	5	2	7	7	1	5	7	7	1	6	5	7	4	1	1	1	3	5	7	7	6	6		
2	IOB	2	33	6	6	7	7	7	7	5	7	6	7	6	6	4	5	5	5	6	5	5	6	5	6	4	4	7	7	2	2	1	3	5	7	3	1	7	4	6	6	6				
3	ZIO	2	37	7	5	7	7	7	7	7	7	7	7	7	7	1	7	4	6	6	1	4	6	6	4	1	7	7	1	1	1	1	7	7	1	1	1	7	7	1	4	7	7			
4	MPS	2	29	7	6	2	6	7	6	4	5	7	2	4	1	5	5	3	3	5	5	3	4	5	6	4	5	7	7	7	6	4	2	6	7	2	1	6	4	7	7	7				
5	DO5	2	29	7	4	7	7	7	7	7	7	7	7	7	7	5	7	4	6	6	7	7	7	5	6	4	1	7	7	1	7	1	5	5	4	4	4	6	1	7	7	7				
6	MPM	2	29	7	5	5	7	7	7	7	7	7	7	7	7	6	6	5	4	6	6	6	6	6	6	4	7	7	1	5	4	5	5	5	3	3	5	5	7	7	7	7				
7	DPA	2	38	7	7	7	7	7	7	6	7	7	7	7	7	7	6	6	7	6	6	5	5	6	4	1	6	6	2	5	2	7	7	6	2	6	6	6	6	6	6	6				
8	BLM	2	27	3	7	7	7	7	7	1	7	7	7	7	7	7	3	3	2	2	6	4	1	4	7	1	1	6	7	1	1	1	6	4	7	4	1	5	7	7	7	7				
9	MDI	2	35	2	7	7	7	7	6	4	7	7	6	5	4	7	5	6	7	6	5	2	4	4	7	2	2	6	7	1	1	1	7	1	4	1	1	5	7	7	7	7				
10	SB8	2	34	2	7	7	7	7	5	2	7	5	3	3	6	5	6	7	7	6	5	6	6	5	6	4	3	5	3	2	2	7	1	1	1	1	6	6	7	7	7					
11	JPB	2	38	7	7	6	7	7	7	4	5	7	6	6	6	7	4	6	7	6	6	3	5	5	5	1	2	6	6	1	1	2	2	7	1	7	3	6	7	7	7	7				
12	UB	2	38	6	6	5	7	7	7	4	5	7	7	6	6	6	6	6	6	7	5	6	6	6	6	6	7	5	7	7	7	6	1	7	7	2	1	4	2	7	7	7				
13	ALV	2	29	5	7	7	6	7	7	4	6	7	7	7	7	3	3	7	2	6	4	4	5	5	2	1	7	2	1	1	7	7	3	1	1	1	7	7	3	1	5	2	7	7		
14	BGV	2	39	7	7	7	7	7	7	7	7	7	6	7	6	7	5	1	6	6	6	6	4	4	1	7	4	5	7	7	1	5	2	5	6	7	7	1	1	6	6	5	5			
15	VJM	2	35	7	5	6	7	7	6	4	5	7	7	7	6	4	2	3	5	6	3	6	4	7	4	1	1	1	7	1	2	1	1	7	6	2	2	2	7	6	6	6	6			
16	JMB	2	34	7	7	7	7	7	7	7	7	7	7	7	7	7	2	2	5	5	6	7	2	2	2	6	6	1	1	7	7	2	5	1	4	6	6	2	2	7	2	7	7			
17	ZCZ	1	28	6	5	7	7	7	7	7	5	7	7	5	5	6	2	6	6	4	6	5	3	6	6	2	2	7	7	1	6	4	6	3	7	3	2	5	4	6	6	6	6			
18	RBA	2	39	6	6	6	6	7	7	6	7	7	7	6	6	6	7	7	6	5	3	4	4	7	1	3	7	7	1	5	3	5	7	1	1	5	6	6	6	6	6	6	6			
19	KMP	2	35	2	6	6	6	7	6	2	7	7	6	5	6	7	3	5	6	6	2	2	2	5	4	3	6	7	7	3	4	4	2	5	7	3	4	7	6	6	6	6	6			
20	SUJ	2	54	6	5	6	7	6	4	4	5	4	5	4	2	5	2	2	6	6	5	5	2	1	7	1	6	7	5	1	4	5	7	2	5	7	2	5	6	3	6	6	6			
21	LKB	2	52	6	4	7	6	7	7	4	5	7	7	7	7	7	1	2	6	5	6	2	3	3	5	6	5	3	7	7	3	2	1	2	3	7	6	2	6	3	7	7	7			
22	DRM	2	37	6	5	4	6	6	6	6	5	5	5	5	6	5	6	5	6	5	6	5	6	5	4	6	6	6	4	6	5	5	5	5	5	5	5	5	5	5	5	5	6	6		
23	ADJ	2	35	5	6	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7		
24	VNZ	2	36	6	4	7	3	7	5	4	6	7	7	7	7	5	11	4	6	6	6	6	6	4	1	7	7	1	5	7	7	1	6	5	7	2	1	1	1	5	5	6	6	6		
25	ZPS	1	33	7	6	6	6	6	6	7	6	6	7	4	7	7	5	1	4	5	6	6	5	4	6	5	6	1	7	5	1	2	1	1	6	6	1	1	6	6	6	6	6	6		
26	KGI	2	28	7	6	7	7	6	7	6	6	6	7	6	6	5	7	6	6	6	6	6	6	4	6	7	4	1	6	6	3	1	1	6	4	7	1	1	5	5	6	6	6	6		
27	DUR	2	52	7	7	5	7	7	7	1	4	7	7	7	1	1	7	1	1	3	4	1	4	7	1	1	6	4	1	1	1	1	1	7	7	7	1	1	7	1	7	7	7	7		
28	DMM	2	53	6	6	6	6	7	6	7	6	6	6	6	6	7	5	6	6	6	5	7	4	4	6	4	2	7	7	1	1	1	7	7	1	7	1	7	1	4	4	5	7	7		
29	ZPT	2	45	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7		
30	AGB	2	37	7	4	7	6	7	7	1	6	7	5	5	6	1	4	7	4	7	4	7	5	2	5	3	2	7	7	1	2	1	4	4	7	3	2	5	5	7	7	7	7	7		
31	MKJ	2	58	7	3	6	7	7	7	1	5	7	6	6	4	6	1	6	4	6	7	1	6	5	1	1	4	4	1	1	1	1	7	1	7	1	1	1	1	5	1	4	4	7	7	
32	CBB	2	26	6	6	7	7	7	4	4	4	4	5	7	6	4	7	3	4	5	3	5	4	4	5	5	6	4	3	7	7	1	5	3	4	5	5	1	1	2	5	5	5	5	5	
33	LET	2	30	6	6	6	7	7	7	5	6	7	5	6	6	6	6	6	6	6	6	6	5	5	6	6	3	6	6	1	3	1	4	6	5	5	4	5	4	6	6	6	6	6		
34	ASZ	2	32	6	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7		
35	MMN	2	29	7	5	4	7	7	4	3	3	4	6	5	5	6	2	5	7	5	6	4	3	6	7	4	4	6	6	3	4	4	4	5	7	4	4	5	7	4	4	6	7	5	6	6
36	SMA	2	52	5	5	5	7	6	6	7	6	7	7	7	7	7	7	6	6	3	5	1	1	7	1	1	1	7	7	1	1	1	5	5	7	7	1	4	4	4	4	4	4	7	7	
37	IRD	2	53	7	6	6	7	7	6	2	7	4	5	7	7	6	4	4	6	7	5	4	4	6	7	4	1	7	7	4	4	1	1	7	7	1	1	7	7	1	1	7	1	6	7	
38	IAN	2	41	7	6	6	7	7	7	7	7	7	7	7	7	6	2	2	6	6	6	6	2	6	6	1	7	7	1	1	1	7	7	1	1	1	7	7	1	1	1	1	7	7		
39	WAN	2	28	6	6	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7		
40	ADL	2	46	7	4	7	7	7	7	4	7	7	7	7	7	7	4	4	4	7	4	7	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
41	TTL	2	36	3	4	3	4	4	3	3	5	7	7	7	6	4	2	3	5	6	3	6	4	7	4	4	1	1	1	7	1	2	1	1	7	6	2	2	2	7	6	6	6	6		
42	RPB	2	42	1	7	5	4	7	5	7	6	5	7	7	7	5	4	5	4	5	4	7	3	4	3	6	4	7	5	3	7	1	4	1	4	4	7	4	7	4	7	4	7	7	7	
43	APV	2	41	7	7	5	4	7	6	4	5	6	6	6	6	5	4	4	6	5	4	3	7	5	7																					

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SURVEY SCORE (PRE)

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CLINICAL CASES - PARTICIPANTS' ANSWERS (POST-WORKSHOP)

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7	6	7	7	7	6	6	7	7	7	7	6	1	7	4	7	7	1	5	7	7	3	1	7	7	3	2	2	7	6	7	1	4	2	3	7	7				
7	6	7	7	7	7	7	7	7	7	7	7	7	1	7	5	6	7	5	5	7	7	1	1	7	7	1	6	1	1	5	7	1	1	7	4	7	7			
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7	7	7	7	7	7	7	7	7	7	7	7	7	4	7	4	4	7	7	7	7	1	7	3	7	7	1	7	7	4	1	7	7	4	1	7	6	6	7		
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7	7	6	7	6	4	6	7	7	7	6	5	7	6	6	7	6	7	5	4	7	6	3	7	7	7	1	3	1	6	1	5	2	7	6	7	6	7	7		
6	7	6	7	7	4	6	6	7	7	7	4	6	7	6	6	6	7	4	3	7	2	1	7	7	1	2	1	7	4	7	1	7	6	6	7	7	7	7		
7	7	7	6	6	7	6	6	6	6	7	7	6	6	7	5	6	6	7	5	6	6	5	6	4	5	6	5	7	6	6	7	1	1	1	6	5	6	7	7	
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7	7	7	7	7	4	6	7	7	7	7	7	7	4	7	6	7	6	4	5	6	4	5	6	4	5	6	5	7	6	6	7	1	1	2	1	7	7	7	7	
7	7	7	7	7	7	7	7	7	7	6	6	4	1	7	3	6	6	3	5	7	4	2	6	5	7	4	2	6	5	7	1	2	1	5	5	5	5	5	5	
5	7	6	5	6	4	4	5	5	7	7	2	3	7	4	4	7	4	2	4	2	4	7	1	1	7	7	1	5	1	3	7	7	1	1	2	5	6	6	6	
7	7	7	7	7	7	7	7	7	7	6	6	7	1	7	4	5	7	2	4	5	7	2	7	7	1	2	7	7	3	5	2	5	6	6	6	6	6	6	6	
7	7	7	7	7	7	7	7	7	7	6	6	7	1	7	4	5	6	7	5	6	6	3	5	6	6	3	1	7	7	3	1	1	7	4	7	1	6	6	6	6
7	7	7	7	7	7	7	7	7	7	6	6	7	1	7	4	5	6	7	5	6	6	3	5	6	6	3	1	7	7	3	1	1	7	4	7	1	6	6	6	6
7	7	7	7	7	7	7	7	7	7	6	6	7	1	7	4	5	6	7	5	6	6	3	5	6	6	3	1	7	7	3	1	1	7	4	7	1	6	6	6	6
7	7	7	7	7	7	7	7	7	7	6	6	7	1	7	4	5	6	7	5	6	6	3	5	6	6	3	1	7	7	3	1	1	7	4	7	1	6	6	6	6
7	7	7	7	7	7	7	7	7	7	6	6	7	1	7	4	5	6	7	5	6	6	3	5	6	6	3	1	7	7	3	1	1	7	4	7	1	6	6	6	6
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SURVEY SCORE (POST)

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For peer review only

BMJ Open

Improving community pharmacists' clinical knowledge to detect and resolve drug-related problems in Croatia: a before/after survey study investigating the efficacy of an educational intervention

Journal:	<i>BMJ Open</i>
Manuscript ID	bmjopen-2019-034674.R2
Article Type:	Original research
Date Submitted by the Author:	05-Feb-2020
Complete List of Authors:	Zekan, Lovre; Split-Dalmatia County Pharmacy; University of Split School of Medicine, Department of Pharmacy Mestrovic, Arijana; University of Split School of Medicine, Department of Pharmacy; Pharmaexpert LLC Perisin, Ana; University of Split School of Medicine, Department of Pharmacy Bukic, Josipa; University of Split School of Medicine, Department of Pharmacy Leskur, Dario; University of Split School of Medicine, Department of Pharmacy Rusic, Doris; University of Split School of Medicine, Department of Pharmacy Modun, Darko; University of Split School of Medicine, Department of Pharmacy
Primary Subject Heading:	Medical education and training
Secondary Subject Heading:	Public health, General practice / Family practice, Pharmacology and therapeutics
Keywords:	EDUCATION & TRAINING (see Medical Education & Training), THERAPEUTICS, PRIMARY CARE

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3 1 **Improving community pharmacists' clinical knowledge to detect and resolve**
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6 2 **drug-related problems in Croatia: a before/after survey study investigating**
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9 3 **the efficacy of an educational intervention**
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Abstract

Objectives: The aim of this study was to increase the knowledge level of community pharmacists in Croatia to identify and resolve drug-related problems (DRPs).

Design: Before/after survey study.

Setting: University of Split School of Medicine.

Participants: 115 community pharmacists from all over the Croatia.

Interventions: An interactive three-day clinical pharmacy workshop with the goal of increasing the knowledge level of community pharmacists in Croatia to identify and resolve DRPs in routine practice. Teaching methods were based on interactive clinical case solving.

Outcome measure: Change of the community pharmacists' knowledge based on pre- and post-workshop evaluation. Survey-based clinical knowledge measurement tool was used in order to evaluate the efficacy of the workshop. The lowest possible total score was 0 and the highest was 80. A higher survey score indicates a higher level of clinical knowledge to identify and resolve DRPs.

Results: Participating pharmacists had significantly higher post-workshop mean survey score (49.1 ± 8.0) than the pre-workshop mean survey score (42.9 ± 8.2), with the mean score difference of 6.2 (95% CI: 4.3 to 8.1). Furthermore, it was found that community pharmacists significantly increased their survey scores, regardless of their age.

Conclusions: Interactive and case-based clinical pharmacy workshop could be a valuable tool to increase the knowledge of community pharmacists about identification and management of DRPs in routine practice. However, further studies are necessary to evaluate the long-term knowledge maintenance and the improvement in patients' clinical outcomes.

46 **Article Summary**

47 **Strengths and limitations of this study**

- 48
- 49 • This study included 115 community pharmacists from all over the country, and out of
50 them 88 completed the survey both times, which is about 4% of all community
51 pharmacists in Croatia.
 - 52 • Educational intervention was interactive and case-based, and survey-based clinical
53 knowledge measurement tool was validated previously and successfully used in
54 Australia.
 - 55 • Follow-up evaluations are needed in order to evaluate the long-term efficacy of the
56 educational intervention.
 - 57 • The participation was voluntary and this could compromise the representativeness of the
58 sample.

59 **Introduction**

60 Drug-related problems (DRPs) represent a public health problem, both in terms of patient
61 outcomes and healthcare expenditures, as they can ultimately lead to drug-related complications,
62 such as drug-related morbidity or mortality. Community pharmacists, as contributors to patient
63 care, should assess data concerning untoward effects of drugs and be well skilled to recognize
64 and prevent these drug-related complications, which result from unidentified or unresolved
65 DRPs.^{1 2} The pharmaceutical care concept, as one of the pillars of modern pharmacy services,
66 assumes clinical interventions which lead to optimal health outcomes. Identification, prevention
67 or resolution of DRPs improves patient's health outcomes, and therefore it should be integrated
68 within pharmaceutical care.^{3 4} However, community pharmacists must have the extensive clinical

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3 69 knowledge and the sufficient training in order to identify and resolve DRPs. Therefore,
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5 70 knowledge and training are important prerequisites to efficiently provide pharmaceutical care.⁵⁻⁹
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9 71 In our previous study, it was suggested that the additional education of community pharmacists
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11 72 in Croatia is associated with the higher level of clinical knowledge to detect and resolve DRPs (β
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13 73 = 0.272, $P < 0.001$).¹⁰ It was concluded that the additional education could increase the
14
15 74 community pharmacists' knowledge level and thus probably make pharmaceutical care
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18 75 implementation more effective. Furthermore, using the same knowledge measurement tool, it
19
20 76 was found that community pharmacists from Australia compared to the colleagues from Croatia
21
22 77 seem to have a higher level of clinical knowledge to detect and resolve DRPs.¹¹ This finding
23
24 78 indicated a general need for the improvement in the knowledge level of community pharmacists
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26
27 79 in Croatia. This was not an unexpected finding, since clinical pharmacy and pharmaceutical care
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29 80 models are still in the initial stages of development in Croatia. Firstly, Centre for Applied
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31 81 Pharmacy was established at the University of Zagreb Faculty of Pharmacy and Biochemistry in
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33 82 2004. Afterwards, clinical pharmacy was the first subject to be introduced to the revised
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35 83 pharmacy curricula. Patient-oriented subjects such as pharmacotherapy, communication skills,
36
37 84 pharmacy practice and pharmaceutical care were introduced between 2006 and 2009.¹² At that
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39 85 time, University of Zagreb Faculty of Pharmacy and Biochemistry was the only faculty for
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41 86 education of pharmacists in Croatia. Consequently, the majority of today's practicing community
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43 87 pharmacists did not attend courses on these disciplines as a part of their graduate education due
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45 88 to the unavailability of such courses. Furthermore, the most of available education for licensed
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47 89 community pharmacists was aimed at promoting the products and consequently was without
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49 90 significant benefits to pharmacists' knowledge about DRPs.
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3 91 Previously, Mestrovic et al. also identified that community pharmacists in Croatia lack skills in
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5 92 the areas of monitoring drug therapy, patient consultation and the evaluation of outcomes, and
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7 93 that they believe they need to complete supplemental educational programs to be able to
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10 94 efficiently provide pharmaceutical care.¹³

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13 95 Therefore, there seems to be a need for an additional education programs that could fill the gap
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15 96 in community pharmacists' knowledge about DRPs, and presumably improve patients' health
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17 97 outcomes. Highly interactive and multifaceted learning methods, such as workshops are reported
18
19 98 to be highly effective strategies to improve knowledge, professional practice and healthcare
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21 99 outcomes.¹⁴⁻¹⁷ Furthermore, continuing education programs in the form of an educational
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23 100 workshop have shown to improve community pharmacists' knowledge and clinical skills in
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25 101 practice.^{5 12 18-20} Hence, we planned an educational intervention in the form of a workshop with
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27 102 the goal of improving the clinical knowledge level of community pharmacists in Croatia.
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32 33 103 **Methods**

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36 37 105 **Workshop setting**

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41 106 A three-day clinical pharmacy workshop for community pharmacists in Croatia was organized.
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43 107 Workshop was advertised nationwide, with the help of Croatian Chamber of Pharmacists and
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45 108 Croatian Pharmaceutical Society. Participation was voluntary and community pharmacists from
46
47 109 all over Croatia participated. The workshop lasted for a total of 20 hours, and during that time
48
49 110 various topics in the area of clinical pharmacy and pharmacotherapy were discussed, as shown in
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51 111 Table 1.
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112 Table 1. Curriculum of the workshop

Topic	Number of teaching hours	Main teaching method
Pharmaceutical care in practice	1	Formal lectures
Rational pharmacotherapy and drug-related problems	1	Formal lectures
Clinical pharmacy and evidence-based medicine	1	Formal lectures
Routine laboratory tests	1.5	Clinical case solving
Food and drug interactions	1	Clinical case solving
Pharmacokinetic and pharmacodynamic interactions	1	Clinical case solving
Hormone therapy	1.5	Clinical case solving
Psychotropic drugs and antidepressants	1.5	Clinical case solving
Antimicrobial drugs	1.5	Clinical case solving
Rare diseases	1.5	Clinical case solving
Hypertension and anticoagulants	1	Clinical case solving
Dyslipidemia and diabetes	1	Clinical case solving
Narrow therapeutic index drugs	1.5	Clinical case solving
Medication errors	2	Clinical case solving
Priority assessment in pharmacotherapy	2	Clinical case solving

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3 113 The workshop was held in a lecture hall at University of Split School of Medicine with the help
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5 114 of assistants and pharmacy students. They supervised all participants during the workshop, and
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7 115 participants who did not attend all sessions were considered to have dropped out from the study.
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10 116 A pharmacist and a pharmacologist were trainers who prepared and presented workshop
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12 117 materials and discussions. Both trainers have appropriate education and qualifications, for
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14 118 example the pharmacist is a competency development manager and lecturer of pharmaceutical
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16 119 care with a PhD and ambulatory care specialization from American College of Clinical
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18 120 Pharmacy and the pharmacologist is a professor of pharmacology and clinical pharmacy at
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20 121 University of Split School of Medicine. Furthermore, key elements of an effective educational
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22 122 activity, like formal lectures and interactive clinical case solving and exercises, were
23
24 123 incorporated into the program. The workshop was designed to provide a brief overview about
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26 124 each topic, but then clinical cases were solved and discussed for the most of the workshop time.
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29 125 Cases were prepared according to the clinical case models available in the literature.^{21 22} By
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31 126 lifting the letter card, each participant had to answer for which of the 4 statements in each case
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33 127 he thought was the most correct. After all participants had revealed their answers, discussion on
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35 128 each statement followed. Participants were also invited to present a few of their own cases from
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37 129 routine practice. From 150 clinical cases, one of the most important learning objectives was
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39 130 increasing the knowledge through the identification and resolution of DRPs in the presented
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41 131 cases. Other learning objectives included developing skill of decision-making process in routine
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43 132 practice, priority assessment in pharmacotherapy and general introduction to the concept of
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45 133 pharmaceutical care.
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51 52 53 134 **Evaluation of the workshop efficacy** 54 55 56 57 58 59 60

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3 135 In order to assess the level of the clinical knowledge of participating community pharmacists
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5 136 pre- and post-workshop, we used a validated survey-based clinical knowledge measurement tool
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7 137 developed by Williams et al.¹¹ ('supplementary file Survey') Also, the same tool was used in a
8
9 138 cross-sectional study with the aim of determining the clinical knowledge level of community
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11 139 pharmacists in Croatia to identify, evaluate and resolve DRPs, as it was previously reported.¹⁰
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13 140 The survey was structured on nine clinical cases with a total of 40 statements. Clinical cases
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15 141 were based on scenarios that were found to occur frequently in community pharmacies in
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17 142 Australia. Each clinical case was supposed to assess a pharmacist's ability to identify, resolve
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19 143 and evaluate a DRP. The survey was originally validated in Australia, and only validation
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21 144 verification has been carried out in Croatia. Since the same clinical cases with the same DRPs
22
23 145 can be routinely found in Croatian community pharmacy practice, authors agreed that the survey
24
25 146 was transferable and appropriate for use in Croatia. Therefore, survey was translated to Croatian,
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27 147 and afterwards to confirm the validity of translation, the back-translation from Croatian to
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29 148 English was carried out by a fluent English speaker and experienced biomedical scientist,
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31 149 blinded to the study details and the original wording. The survey was composed in a manner that
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33 150 all participants were asked to read short case scenarios and select how relevant, likely or
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35 151 appropriate they found each of the proposed statements using a seven-point Likert scale. In the
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37 152 first three clinical cases each statement was about additional information that would be relevant
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39 153 to acquire for that case, while the next three cases consisted of statements which described
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41 154 potential DRPs in each case and the final three cases consisted of statements about possible
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43 155 recommendations for the patients. Since the clinical cases were supposed to assess pharmacists'
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45 156 ability to manage DRPs, the type of knowledge that was measured is mostly procedural
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47 157 knowledge, as it includes decision making and problem solving in routine practice. However, to
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3 158 be able effectively perform these procedures in practice, pharmacists' procedural knowledge
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5 159 must be based on extensive declarative knowledge.
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9 160 All participating community pharmacists were invited on-site to independently complete the
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11 161 survey twice: at the beginning of the workshop and three days later at the end of the last session
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13 162 of the workshop. Participating pharmacists were supervised to complete the survey
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15 163 independently and without access to additional resources or literature. The survey was
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17 164 anonymous, providing only the participant's age, gender and a simple code to match the
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19 165 participants' results before and after the workshop. Study size calculation was not applicable
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21 166 because survey score difference which is associated with significant changes in routine practice
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23 167 is still not known. Therefore, all participating pharmacists were included in this study, except
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25 168 pharmacists who participated in the previous nationwide cross-sectional study, which was the
26
27 169 only exclusion criteria.¹⁰
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33 170 **Data collection and statistical analysis**

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36 171 Afterwards, all data were collected in a Microsoft Excel® worksheet (version 15, Redmond,
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38 172 WA, USA) and each completed survey was evaluated and scored. ('supplementary file Dataset')
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40 173 All statements were scored individually and each statement received a score of 2, 1 or 0
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42 174 depending how far away the answer was from the correct answer. The lowest possible total score
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44 175 was 0 and the maximum possible 80. A higher score indicates a higher level of clinical
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46 176 knowledge to detect, evaluate and resolve DRPs, as previously described.¹¹
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51 177 Statistical calculations and analyses of the data were performed using the IBM SPSS ® statistical
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53 178 package (version 20, Armonk, NY, USA). The graphical figure was prepared with the GraphPad
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3 179 Prism software (version 6, La Jolla, CA, USA). Mean scores of the study participants were
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5 180 analyzed with the independent samples and paired samples *t*-test. Normality of data was checked
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8 181 with the Kolmogorov-Smirnov and the Shapiro-Wilk tests. Pearson's correlation was used to
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10 182 correlate pharmacist's score with age. For all tests, a $P < 0.05$ was considered to be statistically
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12 183 significant. All values are presented as mean \pm SD.

16 184 **Aim of the study**

19 185 The aim of this study was to increase the knowledge level of community pharmacists in Croatia
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21 186 to identify and resolve DRPs. Primary research outcome was the change of the community
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23 187 pharmacists' knowledge based on pre- and post-workshop evaluation. In addition, age and
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25 188 gender subgroup analysis was performed.

29 189 **Ethics Committee approval**

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33 190 This study was approved by the University of Split School of Medicine Ethics Committee (003-
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35 191 08/15-03/0001) and each participant consented verbally to participate in the study, as approved
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37 192 by the Ethics Committee. Verbal consent was considered to be appropriate because of the
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39 193 favorable risk/benefit ratio for the participants. The intervention was educational and the
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41 194 assessment tool was the written survey so there were no particular risks for the study
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44 195 participants.

48 196 **Patient and public involvement**

197 No patients were involved in the design, recruitment and conduct of the study. The study
 198 participants voluntarily accepted to participate in this study, and they were familiarized with all
 199 the risks and benefits. They accepted the possibility that results of the study could be published.

200 **Results**

201 Overall, 115 community pharmacists attended the workshop, 9 were excluded due to having
 202 previously completed the survey and in total 88 pharmacists completed the survey both times.
 203 This represents about 4% of all community pharmacists in Croatia.²³ The response rate, as shown
 204 in Table 2, was satisfactory because participation was voluntary and some participants dropped
 205 out before the end of the workshop. Matching method with the simple code was effective, which
 206 resulted in the successful matching of study participants for further data extraction and
 207 evaluation.

208 Table 2. Demographics of the matched study participants

	Community pharmacists
Age (mean \pm SD)	36.6 \pm 9.2
Female (%)	90.9
Male (%)	9.1
Response rate (%)	83.0

209 Participating pharmacists had a pre-workshop mean score of 42.9 ± 8.2 , and post-workshop
 210 mean score of 49.1 ± 8.0 , as presented in Fig 1. The mean score difference of 6.2 ± 9.0 , which

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3 211 represents a 14.5% relative increase, was found to be significant with the paired samples *t*-test (*t*
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5 212 = 6.488, *P* < 0.001).

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9 213 Fig 1. Pre- and post- workshop survey scores of participating community pharmacists by age and
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11 214 gender subgroups
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15 215 (Figure 1)

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18 216 Furthermore, male pharmacists had a pre-workshop mean score of 42.6 ± 4.2 , while female
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20 217 pharmacists had a pre-workshop mean score of 42.9 ± 8.5 , with no significant difference
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23 218 between the scores with the independent samples *t*-test (*t* = -0.09, *P* = 0.93). However, after the
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25 219 workshop only female pharmacists significantly increased their mean score (paired samples *t*-
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27 220 test, *t* = 6.744, *P* < 0.001), with the mean score difference of 6.9 ± 9.1 .

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31 221 Pharmacists in both age subgroups significantly increased their mean scores after the workshop
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33 222 (paired samples *t*-test, *t* = 4.786, *t* = 4.342, *P* < 0.001) with nearly the same improvement, as
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35 223 presented in Fig 1. Interestingly, there was no significant difference in the survey scores between
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38 224 age subgroups and we found no correlation between pharmacists' survey scores and their age
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40 225 (Pearson's *r* = 0.009, *n* = 88, *P* = 0.933).

41 42 43 44 226 **Discussion**

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47 227 The intensive three-day educational workshop on clinical pharmacy seemed to significantly
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49 228 increase the clinical knowledge of community pharmacists in Croatia to detect and resolve
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51 229 DRPs. This finding implies that an intensive case-based educational intervention could
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54 230 potentially fill the gap in community pharmacists' knowledge about DRPs.

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3 231 From similar studies, Currie et al. proved that the intensive educational program in
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5 232 pharmaceutical care skills and implementation of these skills in practice successfully increased
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7 233 the rate of identified DRPs.²⁴ They used the 40-hour training program in two parts with the focus
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10 234 on the improvement of problem-solving and communication skills. Their training program did
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12 235 not include clinical pharmacy topics and was solely focused on pharmaceutical care. In addition,
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14 236 Currie et al. evaluated the impact of an educational intervention directly on patients and found
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16 237 that education of pharmacists in pharmaceutical care improves patient outcomes through
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18 238 identification of DRPs. Kimberlin et al. reported that pharmacists who engaged in an educational
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20 239 intervention program more likely assessed DRPs than pharmacists without the educational
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22 240 intervention and this difference held in the 3-month follow-up period.²⁵ Their training program
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24 241 included day-long workshop and home study using a training manual. Furthermore, they
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26 242 evaluated the effectiveness of an intervention by interviewing the patients which indicates better
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28 243 outcomes in routine pharmacy practice. In contrast to this study, results of Kimberlin et al. study
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30 244 are based on elderly patients. Furthermore, recently Lalonde et al. demonstrated that having
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32 245 provided community pharmacists with a short disease-specific training and essential clinical
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34 246 information successfully increased pharmacists' knowledge and clinical skills as well as reduced
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36 247 DRP frequency in community pharmacy practice.²⁶ Lalonde et al. used short 90-minute
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38 248 interactive web based training program on use of medications in chronic kidney disease.
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40 249 Pharmacists in their study completed self-administered questionnaire 12 months later, which
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42 250 showed that pharmacists improved knowledge by 4.5% and clinical skills by 7.4%. Compared to
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44 251 this study it is a smaller relative knowledge increase, however it is maintained a year after
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46 252 educational intervention. According to the Obreli-Neto et al., the majority of continuing
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48 253 education programs were reported to be effective based on the studies' outcome measures.²⁷ It is
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3 254 therefore difficult to compare study results without standardization of outcome measures. Also,
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5 255 studies with similar duration of training and evaluation of participants reported heterogeneous
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7 256 relative knowledge increasement, that ranged from 19% to higher or even 5%, as satisfying.^{28 29}
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11 257 Interestingly, this study also implies that community pharmacists' age does not correlate with
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13 258 their clinical knowledge of detecting and resolving DRPs, while Mestrovic et al. study in the
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15 259 community pharmacy setting in Croatia revealed that the age of participants, presumably through
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17 260 experience, improved competency for recognizing and identifying DRPs.¹² However, the two
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19 261 studies used different tools to assess the pharmacist's ability to manage DRPs, and one study
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21 262 primarily evaluated knowledge while the other study evaluated competency, which further
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23 263 involves skills and attitudes of participants. Competency is the ability of pharmacist to make
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25 264 deliberate choices for handling situations and tasks in professional pharmacy practice by using
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27 265 and integrating knowledge and personal values.³⁰ Assessment of attitudes, skills and personal
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29 266 values requires more sophisticated evaluation methods, for example direct observations and
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31 267 objective structured clinical examinations. Therefore, it is possible that age of pharmacists
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33 268 through experience in practice impacts mostly skills, attitudes and personal values of community
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35 269 pharmacists. As opposed to, pharmacists' knowledge could stagnate over time, especially if it is
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37 270 not renewed with continuous education. This could be the reason for the different findings
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39 271 between the studies, but further research is required in order to clarify this difference. Also, it is
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41 272 interesting that there was no significant difference in the survey scores between age subgroups. It
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43 273 could have been expected that the participants in the younger subgroup should have higher
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45 274 survey scores, considering that this subgroup included pharmacists who studied after the revision
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47 275 of pharmacy curricula. However, first generations of pharmacists who studied under revised
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49 276 program have started working five to six years later, including the obligatory internship,
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3 277 therefore it is very likely that their number was not large enough to detect differences between
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5 278 subgroups. It should be further investigated in the future to verify if the curricular revision led to
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8 279 an improvement in pharmacists' knowledge about DRPs.
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11 280 Furthermore, it was found that after the workshop only female pharmacists significantly
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13 281 improved their clinical knowledge about DRPs, while male pharmacists retained the same level
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15 282 of knowledge as before the workshop. This potentially could be due to a greater emphasis on
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18 283 pharmaceutical care which as a topic could be more appealing to female pharmacists.³¹ However,
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20 284 it is also possible that a small number of male participants (n = 8) was not sufficient to show
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22 285 statistical significance, and therefore this finding is questionable and should be further
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25 286 investigated.
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28 287 Surprisingly, even after the workshop the overall survey scores were also lower than the scores
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30 288 from the original study in Australia.¹¹ Survey was based on clinical cases and DRPs which are
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32 289 relevant in Australian community pharmacy setting. However, the same cases with the same
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34 290 DRPs can be routinely found in Croatian community pharmacy practice, so this could not be the
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37 291 reason for such a difference. As mentioned, this most probably arises from different educational
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39 292 backgrounds and different role of community pharmacists in healthcare systems.¹⁰ Community
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41 293 pharmacists in Croatia are still mostly oriented on traditional pharmacy services like dispensing
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43 294 and supplying of medicines, while additional services, which could expand their role as health
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45 295 care providers, are not available in practice. It is only in the last few years that work has begun to
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47 296 introduce advanced services, like medication review in pharmacy practice. Furthermore, pre-
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49 297 workshop survey scores were also lower than scores in previous nationwide study.¹⁰ However,
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51 298 pharmacists who participated in previous nationwide study were excluded and the only relation
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3 299 with this study is that previous study revealed community pharmacists' general lack of
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5 300 knowledge about DRPs. Also, in previous study participants were community pharmacists from
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7 301 large pharmacy chains while this study presumably included more pharmacists who believed that
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9 302 they lack knowledge in this area, since the participation was voluntary. Authors of the workshop
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11 303 expected this since they knew about community pharmacists' general lack of knowledge about
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13 304 DRPs. Therefore, they decided to use the same survey to evaluate the efficacy of educational
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15 305 intervention.
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20 306 A major limitation of this study is the fact that post-workshop clinical knowledge scores were
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22 307 evaluated only immediately after the workshop, so these results actually represent short term
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24 308 knowledge gain and are therefore not reflective of any sustained improvement in knowledge.
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26 309 However, patient benefits must be continuous and not limited to certain periods of time. As
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28 310 expected, a majority of studies have also confirmed that training programs increase the
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30 311 knowledge of pharmacists immediately after the educational intervention, and only a few studies
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32 312 revealed that these improvements could be maintained for a year or even longer without any
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34 313 further education.^{7 26} Therefore, follow-up evaluations are needed and these results should be
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36 314 supported by conducting a future survey to determine whether improvements were maintained
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38 315 and to further evaluate the efficacy of the educational intervention.
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44 316 Another limitation is the possibility of overestimating the results to the general community
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46 317 pharmacist population since the workshop participation was only voluntary. It is therefore
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48 318 possible that only more motivated and enthusiastic pharmacists attended and thus had a greater
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50 319 improvement in knowledge. It is also possible that any prior training of pharmacists could have
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52 320 impacted the pharmacists' knowledge, although this was the first large scale educational
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3 321 intervention with the goal of increasing knowledge about DRPs in Croatia. Most of the trainings
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5 322 that pharmacists have previously had were in the form of lifelong learning with various topics
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7 323 from pharmacy practice and were not specifically focused on improving knowledge about DRPs.
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9 324 Therefore, since community pharmacists in Croatia have not previously received any training of
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11 325 this type and there were no pharmacists who have completed postgraduate studies, this was
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13 326 probably not a limitation. Also, since study participants were from all over the country and
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15 327 represent both the small privately-owned pharmacies and the large pharmacy chains and
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17 328 participants gender distribution is representative of Croatian community pharmacists population,
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19 329 generalization of these results to the community pharmacy setting is much more applicable.^{32 33}
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25 330 Finally, this study once more confirms previously reported findings that educational
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27 331 interventions through workshops are a useful tool to successfully improve pharmacists'
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29 332 knowledge on various topics in pharmacy practice.^{7 19 34 35} Educational interventions can play a
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31 333 vital role in expanding basic pharmacy education and enhancing pharmaceutical care
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33 334 implementation, especially when insufficient training has been received during undergraduate or
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35 335 graduate studies.³⁶ However, to evaluate the true relevance of these findings for community
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37 336 pharmacy practice, it is still necessary to find out if the increased clinical knowledge level of
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39 337 community pharmacists will result in an increased level of clinical interventions about DRPs in
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41 338 daily practice. For example, one of the clear indicators would be the number of reported adverse
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43 339 drug reactions or documented clinical interventions in this group of pharmacists. If confirmed,
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45 340 these findings could have an important implication for pharmacists' continuing education about
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47 341 DRPs.
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54 342 **Conclusions**

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3 343 The interactive and intensive educational intervention through the three-day clinical pharmacy
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5 344 workshop seems to improve the community pharmacists' knowledge to identify, evaluate and
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7 345 resolve DRPs in a simulated routine practice setting. Therefore, educational interventions could
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10 346 be a valuable tool to fill the gap in pharmacist's knowledge about DRP management. Further
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12 347 studies are necessary in order to evaluate long-term knowledge maintenance and the impact of
13
14 348 these findings in community pharmacy practice.

18 349 **Acknowledgements**

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23 350 The authors are grateful to all participating community pharmacists for making this study
24
25 351 possible and to Shelly Pranic for proofreading this paper.

28 352 **Competing Interests**

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32
33 353 Lovre Zekan is employed by Split-Dalmatia County Pharmacy and Arijana Mestrovic is
34
35 354 employed by Pharmaexpert LLC. The authors further declare that they have no competing
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37
38 355 interests.

41 356 **Funding**

42
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46 357 This research received no specific grant from any funding agency in the public, commercial or
47
48 358 not-for-profit sectors.

51 359 **Author Contributions**

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3 360 DM was the leader of this research. LZ interpreted and analyzed the study data. LZ, AM and DM
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5 361 participated in the workshop preparation. ASP, JB, DL and DR participated in conducting the
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8 362 survey. All authors participated in preparation and approved the final manuscript.
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10 11 363 **Data Availability Statement**

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16 364 All data relevant to the study are included in the article or uploaded as supplementary
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18 365 information.
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20 21 22 366 23 24 25 367 **References**

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7 460 All values are presented as mean \pm SD. Statistically significant differences between pre- and post-workshop scores
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9 461 are marked with a * symbol (paired samples t-test, $P < 0.001$). Median age of the study participants is 36 years. The
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11 462 number of participants in each subgroup is specified in parentheses ().
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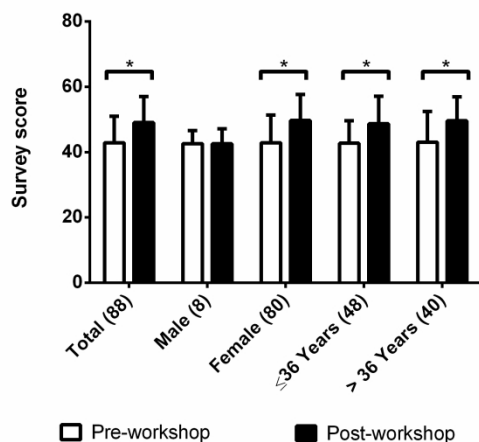


Fig 1. Pre- and post- workshop survey scores of participating community pharmacists by age and gender subgroups

All values are presented as mean ± SD. Statistically significant differences between pre- and post-workshop scores are marked with a * symbol (paired samples t-test, P < 0.001). Median age of the study participants is 36 years. The number of participants in each subgroup is specified in parentheses ().

283x161mm (300 x 300 DPI)

Clinical knowledge measurement tool about drug-related problems

Gender: (M) Male (F) Female Age (years): _____ Code: _____

Instructions: Clinical cases 1 – 3.

For each of the proposed statements, please indicate how relevant it is for each clinical case, by circling the appropriate number on 7-point scale (higher number indicates greater relevance).

Clinical case 1

A slightly overweight, 51-year-old female patient who regularly visits your pharmacy presents a prescription for perindopril 5 mg. The dispensing records indicate that the last antihypertensive agent prescribed for this patient was the perindopril/indapamide combination and it was last dispensed 3 months ago. Please indicate how relevant each piece of additional information would be in this case.

	Totally irrelevant	Moderately irrelevant	Only slightly irrelevant	Neutral	Only slightly relevant	Moderately relevant	Very relevant
1. Discuss with the patient whether the medication change was intentional.	1	2	3	4	5	6	7
2. Discuss with the patient's doctor whether the medication change was intentional.	1	2	3	4	5	6	7
3. Discuss with the patient their compliance with the antihypertensive agent.	1	2	3	4	5	6	7

Clinical case 2

A frail 80-year-old male patient presents to collect his last repeat from his glyceryl trinitrate (GTN) sublingual spray prescription. On dispensing, the pharmacist notices that this is the third time this medication has been dispensed in the last 2 weeks. Please indicate how relevant each piece of additional information would be in this case.

	Totally irrelevant	Moderately irrelevant	Only slightly irrelevant	Neutral	Only slightly relevant	Moderately relevant	Very relevant
4. Determine if the pain the patient is feeling is actually due to angina.	1	2	3	4	5	6	7
5. Ask the patient to demonstrate his administration technique.	1	2	3	4	5	6	7
6. Determine how long since the patient's general practitioner has reviewed his angina treatment.	1	2	3	4	5	6	7
7. Determine how efficacious the GTN spray is.	1	2	3	4	5	6	7

Clinical case 3

A 58 kg, 35-year-old woman presents to the pharmacy to collect a prescription for methotrexate 10 mg weekly from her rheumatologist, which is a new medication for her. Please indicate how relevant each piece of additional information would be in this case.

	Totally irrelevant	Moderately irrelevant	Only slightly irrelevant	Neutral	Only slightly relevant	Moderately relevant	Very relevant
8. Determine if the patient has had baseline liver function tests.	1	2	3	4	5	6	7
9. Determine if the patient has had a negative pregnancy test and is currently taking/using adequate contraception.	1	2	3	4	5	6	7
10. Determine if the side effects of methotrexate have been explained to the patient.	1	2	3	4	5	6	7
11. Determine if the patient has been instructed to take folic acid.	1	2	3	4	5	6	7
12. Determine how often the patient drinks alcohol.	1	2	3	4	5	6	7

Instructions: Clinical cases 4 – 6.
 For each of the proposed statements, please indicate how likely it is for each clinical case, by circling the appropriate number on 7-point scale (higher number indicates higher likelihood).

Clinical case 4

A 65 kg, 45-year-old female patient comes into the pharmacy to enquire about possible side effects. She was commenced on paroxetine 20 mg daily a few days ago and has been experiencing increasing anxiety (which is the reason the paroxetine was initially started), sweating and tachycardia. She has a medical history of atrial fibrillation and severe lower back pain, and is also taking digoxin, ramipril, tramadol and methadone. Please indicate how likely each drug-related problem would be in this case.

	Highly unlikely	Moderately unlikely	Only slightly unlikely	Neutral	Only slightly likely	Moderately likely	Highly likely
13. The commencement of the paroxetine may have resulted in an increase in anxiety for the patient.	1	2	3	4	5	6	7
14. This dose of paroxetine is unlikely to be controlling the patient's anxiety symptoms and an increase in her dose should be considered.	1	2	3	4	5	6	7
15. The paroxetine may have interacted with the tramadol to cause the patient's symptoms.	1	2	3	4	5	6	7
16. The paroxetine may have interacted with the digoxin to cause the patient's symptoms.	1	2	3	4	5	6	7

Clinical case 5

A slightly overweight, 78 year-old female patient with a history of hypertension and mild heart failure presents with prescription for furosemide 20 mg daily to treat her swollen ankles. She is also currently taking lercanidipine 20 mg ramipril 2.5 mg daily, plus amitriptyline 10 mg nightly for sleep. Please indicate how likely each drug-related problem would be in this case.

	Highly unlikely	Moderately unlikely	Only slightly unlikely	Neutral	Only slightly likely	Moderately likely	Highly likely
17. The patient's symptoms are likely to indicate a worsening of her heart failure.	1	2	3	4	5	6	7
18. Lercanidipine could be causing peripheral edema.	1	2	3	4	5	6	7
19. The swollen ankles may be due to an increased fluid intake resulting from hyperglycemia.	1	2	3	4	5	6	7
20. The patient may have syndrome of inappropriate antidiuretic hormone secretion which has led to swollen ankles.	1	2	3	4	5	6	7

Clinical case 6

A woman comes into the pharmacy to collect her elderly husband's prescriptions for him while he is recuperating at home. She states there is a new prescription for 'Imdur (isosorbide mononitrate) 60 mg in the morning' that was started in the hospital last week. The new medication doesn't seem to be working and her husband is still experiencing chest pain. The husband's history shows regular dispensing of pantoprazole 40 mg nightly, clopidogrel 75 mg in the morning, atorvastatin 20 mg nightly, Duride (isosorbide mononitrate) 60 mg nightly, perindopril 5 mg and tiotropium 18 µg in the morning and glyceril trinitrate spray p.r.n. Please indicate how likely each drug-related problem would be in this case.

	Highly unlikely	Moderately unlikely	Only slightly unlikely	Neutral	Only slightly likely	Moderately likely	Highly likely
21. Her husband may be experiencing a decrease in symptom control for his chronic obstructive pulmonary disease and his shortness of breath is causing the chest pain.	1	2	3	4	5	6	7
22. Her husband may be experiencing nitrate tolerance if he has continued to take the Duride brand that he was initially prescribed, as well as the Imdur from the hospital.	1	2	3	4	5	6	7
23. Her husband should have aspirin added to decrease his chest pain symptoms.	1	2	3	4	5	6	7

Instructions: Clinical cases 7 – 9.

For each of the proposed statements, please indicate how appropriate it is for each clinical case, by circling the appropriate number on 7-point scale (higher number indicates higher appropriateness).

Clinical case 7

A slightly overweight, 70-year-old male patient is currently taking warfarin (dose is 5 mg/4 mg on alternate days). He has a dental prescription for an abscess for amoxicillin 500 mg three times a day and metronidazole 400 mg three times a day. Please indicate how appropriate each recommendation would be in this case.

	Totally inappropriate	Moderately inappropriate	Only slightly inappropriate	Neutral	Only slightly appropriate	Moderately appropriate	Very appropriate
24. Cease the warfarin while taking the antibiotics.	1	2	3	4	5	6	7
25. Discuss the interaction with the patient and recommend an increase in international normalised ratio (INR) monitoring while taking the antibiotics.	1	2	3	4	5	6	7
26. Discuss the signs and symptoms of an increased INR with the patient.	1	2	3	4	5	6	7
27. Recommend ibuprofen for pain relief for the dental abscess.	1	2	3	4	5	6	7
28. Halve the warfarin dose while taking the antibiotics.	1	2	3	4	5	6	7
29. Change the warfarin to aspirin while using the antibiotics.	1	2	3	4	5	6	7

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60**Clinical case 8**

A 65 year-old female with airways disease has a recent dispensing history containing Seretide 250/25 (two puffs twice a day and Ventolin inhaler (1–2 p.r.n.). She presents a 3-monthhold prescription to the pharmacist for prednisolone 25 mg, which reads '25 mg twice a day for three days, then 12.5 mg twice a day for three days'. On further discussion, the pharmacist determines that the patient is currently experiencing a worsening of the respiratory symptoms and is unsure what dose of prednisolone she should be taking. Please indicate how appropriate each recommendation would be in this case.

	Totally inappropriate	Moderately inappropriate	Only slightly inappropriate	Neutral	Only slightly appropriate	Moderately appropriate	Very appropriate
30. Advise the patient not to take the prednisolone 25 mg at all.	1	2	3	4	5	6	7
31. Commence over-the-counter pantoprazole 20 mg daily to decrease the risk of gastrointestinal bleeds while taking the prednisolone.	1	2	3	4	5	6	7
32. Contact the patient's general practitioner and determine what prednisolone dose she should currently be taking.	1	2	3	4	5	6	7
33. Advise the patient to cease the Seretide while she is taking the prednisolone tablets.	1	2	3	4	5	6	7
34. Advise the patient to increase the use of her Ventolin inhaler in preference to using the prednisolone.	1	2	3	4	5	6	7

Clinical case 9

120 kg, 40-year-old male smoker with osteoarthritis is taking esomeprazole 40 mg daily, but currently has no gastrointestinal symptoms. The only other medication he is currently taking is regular paracetamol for his osteoarthritis pain that he buys over the counter, and his dispensing history shows ketoprofen and cephalexin dispensed several months ago. Please indicate how appropriate each recommendation would be in this case.

	Totally inappropriate	Moderately inappropriate	Only slightly inappropriate	Neutral	Only slightly appropriate	Moderately appropriate	Very appropriate
35. Recommend the patient return to the general practitioner to reduce his dose to 20 mg daily.	1	2	3	4	5	6	7
36. Recommend the patient return to the general practitioner to trial using esomeprazole on a p.r.n. basis.	1	2	3	4	5	6	7
37. Discuss a weight management programme with the patient.	1	2	3	4	5	6	7
38. Discuss smoking cessation with the patient.	1	2	3	4	5	6	7
39. Recommend the patient have his vitamin B12 levels checked.	1	2	3	4	5	6	7
40. Recommend the patient stop the regular paracetamol and change back to ketoprofen to control his osteoarthritis pain.	1	2	3	4	5	6	7

Disclaimer: All clinical cases are fictional, they do not represent real patients, and were made for the purpose of clinical knowledge measurement tool about drug-related problems.

1-male
2-female

CORRECT ANSWERS:

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CLINICAL CASES - PARTICIPANTS' ANSWERS (PRE-WORKSHOP)

N	PAIRING CODE	GENDER	AGE (years)	ANSWERS																																										
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38					
1	IOB	2	33	6	4	7	3	4	5	7	6	4	7	7	7	7	7	5	14	3	6	6	7	5	2	7	7	1	5	7	7	1	6	5	7	4	1	1	1	3	5	7	7	6	6	
2	IOB	2	33	6	6	7	7	7	7	5	7	6	7	6	6	4	5	5	5	5	6	5	5	5	6	6	4	4	7	7	2	2	1	3	5	7	3	1	7	4	6	6	6			
3	ZIO	2	37	7	5	7	7	7	7	7	7	7	7	7	7	1	7	4	6	6	1	4	6	6	4	1	7	7	1	1	1	1	7	7	1	1	1	7	7	1	4	7	7	7		
4	MPS	2	29	7	6	2	6	7	6	4	5	7	2	4	1	5	5	3	3	5	5	3	4	5	6	4	4	5	7	7	7	6	4	2	6	4	2	6	4	7	2	1	6	4	7	7
5	DO5	2	29	7	4	7	7	7	7	7	7	7	7	7	7	7	5	7	4	6	6	7	7	7	5	6	4	1	7	7	1	7	1	7	1	5	5	4	4	4	6	1	7	7	7	
6	MPM	2	29	7	5	5	7	7	7	7	7	7	7	7	7	7	6	6	5	4	6	6	6	6	6	6	4	7	7	1	5	4	5	5	5	5	3	3	5	5	7	7	7	7	7	
7	DPA	2	38	7	7	7	7	7	6	7	7	7	7	7	7	7	6	6	7	6	6	5	5	6	4	1	6	6	2	5	2	7	7	6	2	6	6	2	6	6	6	6	6	6		
8	BLM	2	27	3	7	7	7	7	7	1	7	7	7	7	7	7	3	2	2	6	4	1	1	4	7	1	1	6	7	1	1	1	6	4	7	4	1	5	7	7	7	7	7	7		
9	MDI	2	35	2	7	7	7	7	6	4	7	7	6	5	4	7	5	6	7	6	5	2	4	4	7	2	2	6	7	1	1	1	7	1	4	1	1	5	7	7	7	7	7	7		
10	SB8	2	34	2	7	7	7	7	5	2	7	5	3	3	6	5	6	7	7	6	5	6	7	5	6	6	4	3	5	3	2	2	7	1	1	1	1	6	6	6	7	7	7	7		
11	JPB	2	38	7	7	6	7	7	7	4	4	5	7	6	6	6	7	4	6	7	6	6	3	5	5	5	1	2	6	6	1	1	2	7	1	7	3	6	7	7	7	7	7	7		
12	UB	2	38	6	6	5	7	7	7	4	5	7	7	6	6	6	6	6	6	6	7	5	6	6	6	6	7	5	7	7	7	6	1	7	7	2	1	4	2	7	7	7	7	7		
13	ALV	2	29	5	7	7	6	7	7	4	6	7	7	7	7	3	3	7	2	6	4	4	4	5	5	2	1	7	7	2	1	1	7	7	3	1	5	2	7	7	7	7	7	7		
14	BGV	2	39	7	7	7	7	7	7	7	7	7	6	7	6	7	5	1	6	6	6	6	4	4	1	7	4	5	7	7	1	5	2	5	6	7	7	1	1	6	6	5	5	5		
15	VJM	2	35	7	5	6	7	7	6	4	5	7	7	7	6	4	2	3	5	6	3	6	4	7	4	1	1	1	7	1	2	1	1	7	6	2	2	2	7	6	6	6	6	6		
16	JMB	2	34	7	7	7	7	7	7	7	7	7	7	7	7	7	2	2	5	5	6	7	2	2	2	6	6	1	1	7	7	2	5	1	4	6	6	2	2	7	2	7	7	7		
17	ZCZ	1	28	6	5	7	7	7	7	7	5	7	7	5	5	6	2	6	6	4	6	5	3	6	6	2	2	7	7	1	6	4	6	3	7	3	2	5	4	6	6	6	6	6		
18	RBA	2	39	6	6	6	6	7	7	6	6	7	7	6	6	6	6	7	7	6	5	3	4	4	7	1	3	7	7	1	5	1	3	5	7	1	1	5	6	6	6	6	6	6		
19	KMP	2	25	2	6	6	6	7	6	2	7	7	6	5	6	7	3	5	5	6	6	2	2	5	4	3	6	7	7	3	4	4	2	5	7	3	4	7	6	6	6	6	6	6		
20	SUJ	2	54	6	5	6	7	6	4	4	5	4	5	4	2	5	2	2	6	6	5	5	2	1	7	1	6	7	5	1	4	5	7	2	5	7	2	5	1	5	6	3	6	6	6	
21	LXB	2	52	6	4	7	6	7	6	7	5	7	7	7	7	7	1	6	5	6	2	3	3	5	6	5	3	7	7	3	2	1	2	3	7	6	2	6	3	7	7	7	7	7		
22	DRM	2	37	6	5	4	6	6	6	6	5	5	5	5	6	2	6	6	4	6	5	3	6	5	5	6	5	4	6	6	4	6	5	5	5	5	5	5	5	5	5	5	5	5	5	5
23	ADA	2	25	5	6	7	7	7	7	7	7	7	7	7	7	7	1	4	4	7	7	7	7	6	5	6	6	1	5	7	7	1	5	6	3	7	7	1	5	6	5	7	7	7	7	
24	VNZ	2	36	6	4	7	3	7	5	4	6	7	7	7	7	7	5	11	4	6	6	6	6	4	1	7	7	1	5	7	7	1	6	5	7	2	1	1	7	2	1	5	5	6	7	7
25	ZPS	1	33	7	6	6	6	6	6	7	6	6	7	4	7	7	5	1	4	5	6	6	5	4	6	5	6	1	7	5	1	2	1	1	6	6	1	1	6	6	6	6	6	6	6	
26	KGI	2	28	7	6	7	7	6	7	6	6	7	6	7	6	6	5	7	6	6	6	6	6	4	6	7	4	1	6	6	3	1	1	6	4	7	1	1	5	5	6	6	6	6	6	
27	DUR	2	52	7	7	5	7	7	7	1	4	7	7	7	7	1	1	7	1	1	3	4	1	4	7	1	1	6	4	1	1	1	7	7	7	1	1	7	7	1	1	7	1	7	7	7
28	DMM	2	53	7	7	7	7	6	7	6	7	6	6	6	6	7	5	6	6	6	5	7	4	4	6	4	6	4	2	7	7	1	1	7	7	1	7	1	7	1	4	4	4	5	7	
29	ZPT	2	45	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	6	7	6	7	6	7	3	4	6	6	7	2	2	7	3	7	3	7	1	1	6	6	7	7	7		
30	AGB	2	37	7	4	7	6	7	7	1	6	7	5	5	6	1	4	7	4	7	5	2	5	5	3	2	7	7	1	2	1	4	4	7	3	2	5	5	7	7	7	7	7	7	7	
31	MKJ	2	58	7	3	6	7	7	7	1	5	7	6	6	4	6	1	6	4	6	7	1	6	5	1	1	1	4	4	1	1	1	7	1	4	7	1	1	1	5	1	5	1	7	7	7
32	CBB	2	26	6	6	7	7	7	4	4	4	4	5	7	4	7	3	4	5	3	5	4	4	5	5	6	4	3	7	7	1	5	3	4	5	5	1	1	2	5	4	6	6	6	6	
33	LET	2	30	6	6	6	7	7	7	5	6	7	5	6	6	6	6	6	6	6	5	5	6	5	5	6	4	3	6	6	1	3	1	4	6	5	5	4	5	4	6	6	6	6	6	
34	ASZ	2	32	6	7	7	7	7	7	7	7	7	7	7	7	7	7	7	6	6	6	6	6	6	5	4	1	7	1	1	1	7	1	4	1	1	1	4	1	4	4	4	4	4	4	4
35	MMN	2	29	7	5	4	7	7	4	3	3	4	6	5	5	6	2	5	5	6	4	3	6	7	4	4	6	6	3	4	4	4	5	7	4	4	5	7	4	4	6	7	5	6	6	6
36	SMA	2	52	5	5	5	7	6	6	7	6	7	7	7	7	7	7	6	6	3	5	1	1	7	1	1	1	7	7	1	1	1	5	5	7	7	1	1	5	5	7	7	7	7	7	7
37	IRD	2	53	7	6	6	7	7	6	2	7	4	5	7	7	6	4	4	6	7	5	4	4	6	7	4	1	7	7	4	4	1	1	7	7	1	1	7	7	1	1	7	1	6	7	7
38	IAN	2	41	7	6	6	7	7	7	7	7	7	7	7	7	7	6	2	2	6	6	6	2	6	6	1	7	1	1	7	7	1	1	1	7	7	1	1	1	1	7	1	7	7	7	7
39	WAN	2	28	6	6	7	7	7	7	7	7	7	7	7	7	7	7	3	5	7	3	7	6	2	6	7	6	2	5	7	7	1	5	4	2	5	7	3	4	5	7	7	7	7	7	
40	ADL	2	46	7	4	7	7	7	7	4	7	7	7	7	7	7	7	4	4	4	7	4	4	7	4	4	4	4	4	7	7	1	4	4	4	7	7	4	1	7	4	7	7	7	7	7
41	TTL	2	36	3	4	3	4	4	3	3	5	7	7	7	6	4	2	3	5	6	3	6	4	7	4	4	1	1	1	7	1	2	1	1	7	6	2	2	2	7	4	7	6	6	6	6
42	RPB	2	42	1	7	5	4	7	5	7	6	5	7	7	7																															

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SURVEY SCORE (POST)

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