

UNIVERSIDADE FEDERAL DO RIO GRANDE DO SUL  
FACULDADE DE FARMÁCIA  
TRABALHO DE CONCLUSÃO DE CURSO

**AN APPLICATION OF LEAN HEALTHCARE TOOLS TO IMPROVE  
MANAGEMENT CAPABILITY IN A TEACHING HOSPITAL CLINICAL  
PHARMACY SERVICE**

Bruna Stella Zanotto

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**An application of Lean healthcare tools to improve management capability in a  
teaching hospital clinical pharmacy service**

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## ABSTRACT

**Background:** The pharmacist's profession has gone from a dispensary-based function for the provision of clinical services. So that, we must consider the importance of management inserted in the clinical routine in order to ensure success of the professional actions of pharmacist in the care process. To identify opportunities for the best use of the clinical pharmaceutical resource in hospitals requires understand how such resources are effectively consumed by patients.

**Objectives and Methods:** This study applied *Lean* principles and tools aiming to understand how clinical pharmacists' resources are effectively consumed by the patients in an academic hospital, using tools such as value stream mapping, the time of the professional involved in those activities, the value-added based activity and activity designation matrix. The data was mainly obtained through interviews with the professionals, time-motion observational studies, chronoanalysis and meeting with head of the sector.

**Results:** The clinical pharmacy services have its value stream map designed considering the relationship of the activities and added-value based. Exploring the map, it is demonstrated that the activity "clinical round" is the most time consuming (27%) is not necessarily considered as value-added for both parts. In addition, there is a long time dedicated to activities that are not identified as valued activities by the pharmacists, and also activities of high value to patient being performed and monitored by trainees.

**Conclusion:** *Lean* healthcare may become a truly positive force once it encourages reflection of the activities performed by the pharmacist professional in a hospital which works in a patient oriented-based care.

Keywords: lean healthcare; clinical pharmacy; pharmacy management; hospital management

## 1. BACKGROUND

1 Hospitals are institutions providing services of great social importance and characterized  
2 by high managerial complexity. The area of health management have a goal that is to  
3 improve the flow of patient care and their needs, for that the quality should seek the  
4 organization of a productive and transparent system for those involved (1). In a healthcare  
5 institution, one of the main services contemplated is the hospital pharmacy (2).  
6 There is a tendency to think the object of the pharmacist's job as the drug prepare (3). But  
7 in the 1970s it began to wonder if the drug really the ultimate purpose of the pharmacist's  
8 job was. After all, producing, acquiring, storing a prescription and delivering the product  
9 does not guarantee its rational use or expected outcome in health (3). It was from such  
10 questions that Mikeal *et al.* (1975) decided to guide a change in the understanding of the  
11 pharmacist's work process, moving towards clinical actions. Not the clinic strictly  
12 instrumental, but a clinic based on the health needs perceived by the user and evaluated  
13 by the professional (3). The profession of pharmacist has moved from a dispensary-based  
14 function to the provision of patient care (4).  
15 As an evolution of the pharmaceutical service, the clinical pharmacist must take into  
16 account the deliver of clinical care, the appliance of the knowledge of semiology and  
17 therapeutics, case discussions with multidisciplinary teams, the transmission of opinions  
18 about the patient and treatment, focusing on adherence to treatment and health outcomes  
19 (5,6).  
20 This context leads Soares *et al.* (2016, p.40) to make an important analogy: one of the  
21 principles of strategic management is the sharing of power in problem identification, in  
22 its explanation, and in the process of finding solutions. This allows us to consider the  
23 importance of management and clinic being the faces of the same service, and which must

24 be articulated to ensure the success of the professional actions of pharmacists in the care  
25 process (3). Thus, the effective management of this human resource, the clinical  
26 pharmacist, is essential for patient care.

27 A promising management approach implemented by some leading healthcare institutions  
28 is *Lean Healthcare*, a philosophy of continuous quality improvement and a set of Toyota  
29 principles (7). It consists of practices that focus on minimizing the total time and  
30 resources need to produce and supply goods or services to a customer, this increasing  
31 efficiency (8). However, it should be emphasized that in health efforts of *Lean* philosophy  
32 must be focused on patient-centered care (9). In particular, in the study by Fisher *et al.*  
33 (2016), the authors make use of *Lean* tools to provide information on the real-time  
34 distribution of pharmaceutical activities thus providing a quality improvement framework  
35 to maximize the application of pharmaceutical expertise in the industry.

36 The core of lean involves determining the value of any given process, which is identified  
37 through the eyes of the patient, distinguishing value-added steps from non-value-added  
38 steps (a process called value stream map) and eliminating waste so that every step  
39 ultimately adds value to the process (10). Most published *Lean* examples in healthcare  
40 highlights the use of specific tools to achieve short-term improvements, such as activity  
41 designation matrix and value stream mapping (8), they also stand out the importance of  
42 this method to increase the internal knowledge of the processes (11,12). Creating a  
43 detailed representation of the process facilitates the understanding of the current state of  
44 the sector (7) hence disclose opportunities for improvement.

45 In order to identify opportunities for the best use of the clinical pharmaceutical resource  
46 in a public academic hospital, the aim of this study is to apply lean principles and tools  
47 to understand how clinical pharmacists' resources are effectively consumed by the  
48 patients. The identification of how pharmacist's activities add value in a patient-oriented



49 center care was a specific objective and was explored detailing how the pharmacists  
50 background and time have been expended to valued activities.

51

## 52 **2. METHODS**

53 Regarding the research approach according to GIL (2002), it is qualitative because it  
54 consists of an interpretation of the data obtained, which will occur for the data crossing  
55 of time measured, activities related and people involved. An exploratory research was  
56 conducted by a *lean* perspective (7) to measure how pharmacists allocate their time  
57 considering the impact of the clinical determinants of patients on the activities of  
58 pharmacists with the ultimate goal to identify information that guides the effective  
59 management of the clinical pharmacy team. The study occurred in the clinical and  
60 surgical unit the of clinical pharmacy service of a public academic Hospital in the South  
61 of Brazil.

62 The research was divided in four main steps: 1) the application of *Lean* tools - value  
63 stream map and activity designation matrix, 2) time data collection, 3) the identification  
64 of value-added and non-value-added steps through interviews with the professionals and  
65 with the manager of the Clinical Pharmacy Service and 4) the cross analysis of activities  
66 time and resources consume versus the activities value.

67 The clinical pharmacy object of this case study is inserted in a public teaching hospital in  
68 Porto Alegre. It consists of 10 clinical pharmacists responsible for 432 inpatient beds.  
69 Clinical Pharmacy session receives and average of 1652 patients per month according to  
70 their data control.

## 2.1 VALUE STREAM MAPPING

71 The value flow map is the diagrammatic representation of the patient's journey through  
72 the system and identifies the stages of the individual during hospitalization; this allows  
73 the team to more clearly see the current state of a complex system and provides guidelines  
74 for improvement (13).

75 The study started from questions to the head of the sector and the pharmacists about what  
76 activities are performed by the pharmacy, what step-by-step by clinical context of the  
77 patient and what is involved in their execution. The other tool that helped to confirm the  
78 process was the pharmaceutical bundle already present and validated in the sector. A  
79 bundle is a structured way of improving the processes of care and patient outcomes: a  
80 small, straightforward set of evidence-based practices that, when performed collectively  
81 and reliably, have been proven to improve patient outcomes (14,15).

82 Also, from the literature Hickshon (2017), Falconer (2014), and Martinbiancho (2012)  
83 we can see that specific patient situations worked as triggers and led to specific tasks,  
84 we then called these triggers as “flags”. In the VSM these flags aim to identify medically  
85 complex patients who often receive a number of high-risk medication and are thus at an  
86 increased risk of medication errors and adverse drug events (ADE), including patients not  
87 staying in their service-specific wards (16) or even that present comorbidities that require  
88 more pharmacist assistance.

89 For those activities that pharmacists do with frequency and which cannot be reported in  
90 the value stream map, because it did not represent the patient's journey, the researchers  
91 defined as triage and others. The last activities class (others) was divided into  
92 administrative (such as service meetings and daily organization of the patient list),  
93 research and education (time spent on residents, trainees and fellows, multidisciplinary

94 residence meetings) and traveling (time walking from one floor to another and hospital  
95 beds).

96 This period of study aimed to understand the logic behind the activities. Besides that, it  
97 took 2 weeks of full observation of the steps taken by the professional to verify the  
98 process. Such detailed knowledge allowed the elaboration of the flow map of value and  
99 the matrix of responsibilities. Before proceeding, the map had its structure granted with  
100 the heads of the service and professionals involved.

101

## 102 2.2 TIME DATA COLLECTION

103 The collection of time and patient's clinical data was done through a chronoanalysis. For  
104 this purpose, the chronoanalysis chart was elaborated (Additional file 1). This tool was  
105 built considering information quickly and easily obtained from the patients taking into  
106 account the activities previously identified on the value stream map (VSM), interrupting  
107 the professional as little as possible during the collection (17). This step took 5 weeks of  
108 measuring time of five pharmacists and one trainee of the unit randomly available at the  
109 moment. The time was measured with a stopwatch. The results of the collection will  
110 compose a database which will be the subsidy to assess which main activities consume  
111 largest proportion of pharmacist time and who are running this activity (10,18).

## 112 2.3 VALUE AND NON-VALUE-ADDED ACTIVITIES

113 Value Adding Activities are any activities that add value to the customer and by his eyes  
114 this activity is directly benefiting him. In the healthcare field, the customer we can see as  
115 the "patient-centered care". It is worth it to highlight that patients typically see value  
116 more broadly, since the benefits received from charges support it (7). It was important to  
117 ask these questions to the professionals who were close to the process and knew how

118 these activities reached the patient in product form, it was an appropriate moment for  
119 reflection as well.

120 The value added and non-value-added activities were defined through interviews with 10  
121 pharmacists of the sector. The interview was recorded and *lean* philosophy was explained  
122 to professionals, including the concept of activities that add or not add value, and then  
123 they were asked to sign which activities, in their perception, add or not add value from  
124 the point of view of the patient. The questionnaire is presented in more detail [see  
125 Additional file 2].

126 The activities which they were asked to categorize were those from the value stream map.  
127 It was emphasized in the interview that required activities are those which must be done,  
128 but they do not necessarily add value. The same was conducted with the manager of the  
129 clinical pharmacy service in order to see the contrast between the clinical pharmacist  
130 operator and the clinical pharmacist manager.

131 Analysis content was conducted with the total of 11 transcribed interviews. The purpose  
132 was elicited the time dedication of the pharmacist to the activities that add and do not add  
133 value. The interviews were transcribed with the purpose of searching which vocabulary  
134 was chosen by the pharmacists and what justified their choice of an activity that adds or  
135 does not value. If there was any pattern of word repetition, we sought to understand how  
136 this was associated with the data found so far. This is also of interest in this study and  
137 represents an opportunity for reevaluation of clinical pharmacy processes. The  
138 preliminaries results were validated in meeting with the head of the pharmacy service and  
139 the clinical pharmacy sector.

## 140 2.4 ACTIVITY DESIGNATION MATRIX

141 The activity designation matrix is inserted in this context in order to define the roles (the  
142 responsible, the authority, the consulted and informed) of each human resource in the  
143 execution of the activities (13). A Responsibility Assignment Matrix (RAM) provides a  
144 way to plan, organize and coordinate work that consists of assigning different degrees of  
145 responsibility to the members of an organization for each activity undertaken in it (19).  
146 It was done concomitantly with the flow map once the researchers were there to observe  
147 activities and in what way they were hierarchical. Just as the result above, the  
148 preliminaries results were validated in meeting with the head of the pharmacy service and  
149 the clinical pharmacy sector.

## 150 3. RESULTS

151 Five pharmacists and one trainee were observed during a total of 7 weeks, counting time  
152 of VSM and time data collection, the last for a combined total of approximately 60,2  
153 hours.

### 154 3.1 VALUE STREAM MAPPING

155 The current state value stream map was created and graphically organized (see Additional  
156 file 3), considering 13 procedural steps and 2 extra activities. A total of 15 activities was  
157 identified as represented in figure 1. The extra group of others represented administrative,  
158 research and education and traveling. In addition to the activities, the flags were patient  
159 having proper medications, cystic fibrosis or antiretroviral therapy, antimicrobials  
160 therapy, coagulation risk, oral chemotherapy, transplant patient, adverse drug events and  
161 warning signaling. Considering the clinical/surgical patient scenario, the flow map has  
162 three main bottlenecks: when the patient is a newone, whether it is included in the  
163 multidisciplinary team and it presents one or more flags.

164 3.2 TIME DATA ANALYSES

165 Five different pharmacists and one trainee were observed over the course of these motion  
 166 periods for approximately 60,2 hours. Triage was not measured during the chronoanalysis  
 167 because is a well-established journey made by all the hospital pharmacists once a week  
 168 during a shift. The results from the chronoanalysis with its relative percentage to the  
 169 activity performed by the pharmacist are demonstrated in table 1.

170 **Table 1.** Task categories used in data collection and percentage of total time investment.

TASKS	PERCENTAGE OF TOTAL TIME	ABSOLUT HOURS	FREQUENCY	UNIT TIME (MINS)
1. Patient's follow up record elaboration	3%	1,73 h	7	14,79
2. Patient's follow up record update	6%	3,40 h	53	3,85
3. Prescription evaluation	2%	0,98 h	32	1,83
4. Triage	NM	NM	NM	NM
5. Clinical round	27%	16,37 h	13	75,58
6. Medical record evaluation	25%	14,90 h	38	23,53
7. Intervention	2%	0,98 h	24	2,44
8. Medical record evolution	2%	1,18 h	14	5,05
9. Pharmacist record's registration	2%	1,05 h	53	1,19
10. Conciliation	2%	1,12 h	11	6,09
11. Validation	1%	0,54 h	8	4,08
12. Discharge orientation	5%	2,87 h	23	7,49
13. Consultancy	2%	1,08 h	8	8,13
14. Pharmacovigilance notification	0,31%	0,19 h	3	3,79
15. Others	23%	13,79 h	90	9,19
15A. Others-administrative	-	1,52h	10	9,12
15B. Others- research and education	-	7,03h	23	18,34
15C. Others- traveling	-	0,77h	21	2,20

171 NM- not measure

172

173 3.3 VALUE-ADDED AND NON-VALUE-ADDED ACTIVITIES

174 An assessment of the current state VSM demonstrated that out of 15 formal activities  
 175 done by the pharmacist in its typical week 7 processes were genuine value-adding

176 processes by mutual consent (professionals and head of service) (Table 2). Those  
 177 activities were prescription evaluation, medical record evaluation, intervention, medical  
 178 record evolution , conciliation, validation and discharge orientation.

179 There were three conflicting activities between that head of the sector and professionals.  
 180 Triage was considered as value-added by the head of the service and the opposite by the  
 181 professionals. On the other hand, the activities that the professionals considered value-  
 182 added and the manager not were “clinical round” and “research and education” (stratified  
 183 by the “Others activity”) (Table 2).

184 **Table 2.** Tasks and added value from professionals and management perspective.

<b>TASKS</b>	<b>ADDED VALUE (FROM PROFESSIONALS)</b>	<b>ADDED VALUE (FROM MANAGEMENT)</b>
<b>1. Patient’s follow up record elaboration</b>	Non-value added	Non-value added
<b>2. Patient’s follow up record update</b>	Non-value added	Non-value added
<b>3. Prescription evaluation</b>	Value added	Value added
<b>4. Triage</b>	Non-value added	Value added
<b>5. Clinical round</b>	Value added	Non-value added
<b>6. Medical record evaluation</b>	Value added	Value added
<b>7. Intervention</b>	Value added	Value added
<b>8. Medical record evolution</b>	Value added	Value added
<b>9. Pharmacist record’s registration</b>	Non-value added	Non-value added
<b>10. Conciliation</b>	Value added	Value added
<b>11. Validation</b>	Value added	Value added
<b>12. Discharge orientation</b>	Value added	Value added
<b>13. Consultancy</b>	Non-value added	Non-value added
<b>14. Pharmacovigilance notification</b>	Non-value added	Non-value added
<b>15A. Others- administrative</b>	Non-value added	Non-value added
<b>15B. Others- research and education</b>	Value-added	Non-value added
<b>15C. Others- traveling</b>	Non-value added	Non-value added

185 The added value from each activity were extracted from the questionnaire applied to the professionals and management  
 186 of the sector

187 3.4 ACTIVITY DESIGNATION MATRIX

188 The activity designation matrix is represented in table 3 and shows how the activity is  
 189 related with the five levels of workforce in the clinical pharmacy sector.

190 **Table 3.** Activity Designation Matrix.

ACTIVITY	Description	Pharmacy Fellow Student	Trainees	Resident	Pharmacy professional	Head of the Service
	1. Patient's follow up record elaboration	P		P / R / I	P / R / I / C	
	2. Patient's follow up record update	P		P / R / I	P / R / I / C	
	3. Prescription evaluation			P / R	P / R	
	4. Triage			P / R	P / R	
	5. Clinical round	I		P / I	P / I	P / R / I / C
	6. Medical record evaluation	P / I	P / I	P / R / I	P / R / I / C	P / R
	7. Intervention			P / R	P / R	P / R
	8. Medical Record Evolution			P	P / R	C
	9. Pharmacist record's registration	P		P / R	P / R	C
	10. Conciliation	P	P	P / R	P / R / I / C	
	11. Validation	P	P	P / R / I	P / R / C	
	12. Discharge orientation	I	I	P / R / I	P / R / I	
	13. Consultancy	P	P	P / R	P / I	
	14. Pharmacovigilance notification			P / R	P / R	
	15a. Others- administrative			P / I		P / R / C
15b. Others- research and education			P / I	P / R	P / R / C	
15c. Others- traveling	P	P	P	P	P	

191 R= Responsible; P= Performer; I= Information User; C= Controls

192 **4. DISCUSSION**

193 The results provide insight into the current time distribution of pharmacist activities at  
 194 this public teaching hospital. The results do not rely on reporting by the pharmacists but  
 195 rather on how their time is actually allocated to different tasks and how these activities  
 196 are being delivered to patient. Our findings demonstrate that the activity that is most time  
 197 consuming is not necessarily considered as value-added for both parts. Multidisciplinary  
 198 ward round is a conquer of the profession of clinical pharmacist that now pharmacists are  
 199 part of healthcare teams in hospitals. There are several studies showing the importance of



200 the pharmacist in the team, suggesting that pharmacists can only make meaningful  
201 contributions in the development or review of disease specific drug treatment guidelines  
202 if they were involved in the actual drugs use in practice (20). Also, intervening with  
203 recommendations to adjust doses, to add or delete drugs to therapy, to monitor laboratory  
204 values, or to identify potential problems at discharge are more difficult to identify and to  
205 respond to in a timely manner because of the pharmacist's distance from the decision-  
206 making process (21).

207 However, it still diffuses the multidisciplinary proposal of this activity once sometimes it  
208 recalls a class for medical students: very focused on diagnosis, medical clinic and  
209 proactivity of students. The involvement of the pharmacist is undoubtedly important but  
210 the way it occurs is questionable and there is space for change. The impression from the  
211 interviews was that participating in clinical rounds every day would be very difficult once  
212 the time of pharmaceutical intervention is not proportional to the time spent participating  
213 in the multidisciplinary rounds, so this would postpone other duties as important as. So  
214 that, in a capacity study we see that clinical pharmacy session has capacity to do so, but  
215 the time spent would not justify. Also, if clinical round was a more objective task, others  
216 professionals involved would optimize their interventions, so that everyone can be aware  
217 of the possible updates in the first moment of meeting.

218 Another conflicting activity was research and education included in "others" category, it  
219 also took a considerable amount of time comparing to the total of tasks. It is quite an  
220 inherent result once it is known that pharmacists often use workarounds to optimize the  
221 amount of time spent on different activities (10). Yet we recognize that introducing new  
222 trainees and fellows into the workflow is a common practice for academic hospitals, and  
223 that these members may take longer and supervision needed to complete the same tasks.

224 On the one hand we can realize the importance of task supervision and conference. Out  
225 of our data we can see that activities with high value added are mostly done by trainees  
226 and fellows. From the activity designation matrix concept (19), it is highlighted the merit  
227 of an external perception once error-prone task is the problem we are all facing when said  
228 manual work. Hence the performer should not be the same individual who controls or is  
229 responsible. In this scenario, during the encounters with the head of the service emerged  
230 the possibility of sampling the fulfilment of those activities that are mostly trainee's role  
231 in a way of controlling the work that is been done and also as a manner of instructing the  
232 task. When external performance measures are considered the method significantly  
233 contribute to enhancing internal project performance (13). The argument about traveling  
234 brought up that value-added activities had displacement as an inherent process. And can  
235 explicit the time required for some activities that are value-added.

236 *Lean* principles have provided us with greater discernment of pharmacist' activities  
237 during the analyses and, as well as in Fisher *et al.* (2016) study, we recognize that this  
238 methodology may cause confusion regarding the pharmacists' categorization of value-  
239 added and non-value-added tasks. In the current workflow, all tasks are necessary but not  
240 exclusively are value-added. This is particularly notable in the classification of patient's  
241 follow up record elaboration and updates as a non-value-added task. However, it is  
242 important to note that *lean* methodology encourages identification of value according to  
243 the patient which explains our use of the value categorizations made by the pharmacists.  
244 Still, a limitation of our study concerns non-interview with other healthcare professionals,  
245 knowing the perspective of these professionals also about their pharmacist value-based  
246 activity could be interesting. The majority of the interviewed understand that as a patient,  
247 they value activities that see them and know their clinic even though those are not all the  
248 activities done in more frequency. Soares *et al.* (2016) advocate that when you present

249 yourself as a pharmacist, it is a process that becomes clinical, more or less complex, but  
250 always towards the production of care. In this way, the production of care we can see  
251 from the results, it is not always generated from meeting in person with the patient, but  
252 the care behind attitudes that make the patient feel cared, as said interventions,  
253 consultancy, medical record evaluation and medical record evolution.

254 *Lean* tools have helped to develop an overview of what the current state is in the clinical  
255 pharmacy section of this hospital. Because they are fully visual tools, they can even serve  
256 as a model for training a new professional in the institution, for example. Understanding  
257 the current state is key to seeing the improvements that can be made as they seek to better  
258 tailor solutions to how improvements should be made than what improvements need to  
259 be made (7,9). In addition, understanding such tools is the first step of a journey of phases  
260 for continuous improvement, which is precisely the transformation *lean* leaning  
261 advocates. Indistinguishably, the issue of value-based management goes a long way with  
262 the concept that all work must be for the patient, directly or indirectly, the resources must  
263 be used to benefit him (7).

264 The applicability of quality control starts making practical changes to the system that will  
265 make a difference to clinicians and patients will go a long way toward engaging end users  
266 in the change effort and gaining their support (22). The *lean* principles offered here may  
267 enable healthcare organizations and managers to pick the right components of a *lean*  
268 program and to better understand the reasons behind value as the center of patient  
269 oriented-based care.

## 270 **5. CONCLUSIONS**

271 *Lean* healthcare may become a truly positive force once it encourages reflection of the  
272 activities made by the pharmacist professional in a clinical/surgical unit from a hospital.

273 In this sense, the process constructed ceases to be a technically elaborated product to  
274 integrate the set of instruments necessary for health and well-being in our society. This is  
275 a reorientation of the focus of attention to seek to meet the needs that impact the health  
276 of the people, with greater resolution of actions.

277 It is difficult to assess the generalizability of our findings because the results represent  
278 the specific scenario of an arm in the pharmacy clinical session, otherwise the applications  
279 of tools and insights we could take from this study generate inquiries. It is known that  
280 transformation generates resistance, but the stimulation of a new mindset may contribute  
281 to performance in clinical pharmacy healthcare.

## **List of abbreviations**

VSM: value stream map

RAM: Responsibility Assignment Matrix

ADE: Adverse Drug Event

## **Declarations**

### ***Ethics approval and consent to participate***

This study was firstly approved by the Hospital Ethics Committee with the Certificate of Presentation for Ethical Appreciation (CAAE) 91676518.6.0000.5327

### **Consent for publication**

Not applicable

### **Availability of data and materials**

All data generated or analysed during this study are included in this published article [and its supplementary information files].

### ***Competing interests***

The authors declare that they have no competing interests.

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### **Authors' contributions**

BSZ and GCB collected, analyzed and interpreted the time data observation regarding VSM. CT, JKM and JRC participated in the meetings during the construction of VSM, RAM. JKM, APE and CAP gave final approval of the version to be published.

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282 Additional file 1. BMC Health Service Research Guidelines

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299 The information below details the section headings that you should include in your  
300 manuscript and what information should be within each section.

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302 The title page should:

- 303 • present a title that includes, if appropriate, the study design e.g.:
  - 304 ○ "A versus B in the treatment of C: a randomized controlled trial", "X is a
  - 305 risk factor for Y: a case control study", "What is the impact of factor X on
  - 306 subject Y: A systematic review"
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  - 308 reports

- 309       • list the full names, institutional addresses and email addresses for all authors
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318   do not cite references in the abstract. Reports of randomized controlled trials should

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320   separate sections:

- 321       • Background: the context and purpose of the study
- 322       • Methods: how the study was performed and statistical tests used
- 323       • Results: the main findings
- 324       • Conclusions: brief summary and potential implications
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- 326       human participants, it must be registered in an appropriate registry and the
- 327       registration number and date of registration should be in stated in this section. If
- 328       it was not registered prospectively (before enrollment of the first participant), you
- 329       should include the words 'retrospectively registered'. See our editorial policies for
- 330       more information on trial registration

331   **Keywords**

332   Three to ten keywords representing the main content of the article.

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334   The Background section should explain the background to the study, its aims, a summary

335   of the existing literature and why this study was necessary or its contribution to the field.

336

337 **Methods**

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- 339 • the aim, design and setting of the study
- 340 • the characteristics of participants or description of materials
- 341 • a clear description of all processes, interventions and comparisons. Generic drug  
342 names should generally be used. When proprietary brands are used in research,  
343 include the brand names in parentheses
- 344 • the type of statistical analysis used, including a power calculation if appropriate

345 **Results**

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347 analysis which must be included either in the text or as tables and figures.

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349 This section should discuss the implications of the findings in context of existing research  
350 and highlight limitations of the study.

351 **Conclusions**

352 This should state clearly the main conclusions and provide an explanation of the  
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- 360 • Consent for publication
- 361 • Availability of data and material

- 362 • Competing interests
- 363 • Funding
- 364 • Authors' contributions
- 365 • Acknowledgements
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445 analyzed and interpreted the patient data regarding the hematological disease and the  
446 transplant. RH performed the histological examination of the kidney, and was a major  
447 contributor in writing the manuscript. All authors read and approved the final  
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646 E.g. **Fig. 3 Liver smear from a 6-week-old embryo (CR length 12 mm)**. A remarkable  
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- 691 • Title of data
- 692 • Description of data

693 Additional files should be named "Additional file 1" and so on and should be referenced  
694 explicitly by file name within the body of the article, e.g. 'An additional movie file shows  
695 this in more detail [see Additional file 1]'.  
696

696 For further guidance on how to use Additional files or recommendations on how to  
697 present particular types of data or information, please see How to use additional files.

698 File size and resolution

699 The maximum file size for additional files is 20 MB each and files will be virus-scanned  
700 on submission.

701 Data over 20 MB should be deposited in a suitable permanent repository for that type of  
702 data, where one exists (e.g. GEO for microarray data). Please see our list of recommended  
703 repositories for guidance.

704 Additional files can be submitted in any format

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**Figure 1 – Clinical pharmacist’s activities identified.** (i) patient’s follow up record update, (ii) patient’s follow up record update (iii) prescription evaluation, (iv) triage, (v) clinical round, (vi) medical record evaluation, (vii) intervention, (viii) medical record evolution, (ix) pharmacist record’s registration, (x) conciliation, (xi) validation, (xii) discharge orientation, (xiii) consultancy, (xiv) pharmacovigilance (xv) others.

Additional file 1. Chronoanalysis Chart

TASKS		FLAGS #
1. Patient's follow up record elaboration	9. Pharmacist record's registration	1. Proper medications
2. Patient's follow up record update	10. Conciliation	2. Cystic Fibrosis or Antiretroviral Therapy
3. Prescription evaluation	11. Validation	3. Antimicrobial Therapy
4. Triage	12. Discharge orientation	4. Coagulation risk
5. Clinical round	13. Consultancy	5. Oral Chemotherapy
6. Medical record evaluation	14. Pharmacovigilance notification	6. Transplant
7. Intervention	15. Others	7. ADE
8. Medical record evolution		8. Warning Signaling

Medical Record #	Age	Pharmacist name	Date	Task	Time (sec)	Flag		Flag #	Unit		Team		New patient?	Considerations
						Yes	No		Surgical	Clinical	Y	N		

Additional file 2 – Questionnaire Estructure.

*Lean Healthcare* -> a philosophy of continuous quality improvement and a set of Toyota principles. Some tools used for Lean application are value stream map and accountability matrix.

In health, efforts of the *Lean* philosophy should be focused on patient-centered care.

Our proposal with the Pharmacy Clinic was to carry out the following project to apply *Lean* tools that could serve as a basis for a future scenario modeling to assess the capacity of the clinical / surgical sector.

The idea of adding value to products and services is a key concept of Lean and should be made from the point of view of customers. It is defined as anything the customer would be willing to pay because it directly benefits him. That is:

What does the customer VALUATE in our process?

What activities will he really feel willing to reward us for?

In the case of Lean Healthcare, when we think of product / customer / final destination, this is our "patient care". Everything that directly benefits those who are at the tip (patient, care) adds value to it.

It is not trying to categorize what should or should not be done, because some activities do not add value and MUST be done.

Thinking about a car industry, the logistics industry never adds value to the end customer, but it's a necessary industry. Already the process of Welding, Turning, Assembly in the manufacture of the car itself, is an activity that adds value because the customer wants to pay for it.

All of the following activities are done and have their due importance, but please mark with and X those that aggregate value or not add value.

<b>Tasks</b>	<b>Added value</b>	<b>Non-added value</b>
<b>1. Patient's follow up record elaboration</b>		
<b>1. Patient's follow up record elaboration</b>		
<b>3. Prescription evaluation</b>		
<b>4. Triage</b>		
<b>5. Clinical round</b>		
<b>6. Medical record evaluation</b>		
<b>7. Intervention</b>		
<b>8. Medical record evolution</b>		
<b>9. Pharmacist record's registration</b>		
<b>10. Conciliation</b>		
<b>11. Validation</b>		
<b>12. Discharge orientation</b>		
<b>13. Consultancy</b>		
<b>14. Pharmacovigilance notification</b>		
<b>15. Others</b>		
<b>15a. Others- administrative</b>		
<b>15b. Others- research and education</b>		
<b>15c. Others- traveling</b>		

