



Original Research

# Pharmaceutical services cost analysis using time-driven activity-based costing: A contribution to improve community pharmacies' management

João Gregório, Pharm.D., M.P.H. <sup>\*</sup>, Giuliano Russo, Dr.P.H. <sup>1</sup>,  
Luís Velez Lapão, M.Sc., Ph.D. <sup>1</sup>

*Global Health and Tropical Medicine, Instituto de Higiene e Medicina Tropical, Universidade Nova de Lisboa, Rua da Junqueira, no 100, 1349-008 Lisboa, Portugal*

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## Abstract

**Background:** The current financial crisis is pressing health systems to reduce costs while looking to improve service standards. In this context, the necessity to optimize health care systems management has become an imperative. However, little research has been conducted on health care and pharmaceutical services cost management.

**Aim:** Pharmaceutical services optimization requires a comprehensive understanding of resources usage and its costs. This study explores the development of a time-driven activity-based costing (TDABC) model, with the objective of calculating the cost of pharmaceutical services to help inform policy-making.

**Methods:** Pharmaceutical services supply patterns were studied in three pharmacies during a weekday through an observational study. Details of each activity's execution were recorded, including time spent per activity performed by pharmacists. Data on pharmacy costs was obtained through pharmacies' accounting records.

**Results:** The calculated cost of a dispensing service in these pharmacies ranged from €3.16 to €4.29. The cost of a counseling service when no medicine was supplied ranged from €1.24 to €1.46. The cost of health screening services ranged from €2.86 to €4.55.

**Conclusion:** The presented TDABC model gives us new insights on management and costs of community pharmacies. This study shows the importance of cost analysis for health care services, specifically on pharmaceutical services, in order to better inform pharmacies' management and the elaboration of pharmaceutical policies.

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**Keywords:** Pharmacy management; Time-driven activity-based costing; Pharmaceutical services; Community pharmacy

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## Introduction

An aging population and an increasing prevalence of chronic diseases in OECD countries, with the associated rising costs of care, have long been

considered the main threat to the sustainability of global health systems. <sup>1</sup> The economic crisis affecting some OECD countries became another driver pressing health systems to ration expenditures while

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<sup>1</sup> Tel.: +351 213 652 600.

\* Corresponding author. Tel.: +351 213 652 600.

E-mail address: [jgregorio@ihmt.unl.pt](mailto:jgregorio@ihmt.unl.pt) (J. Gregório).

preserving quality and access to health care services.<sup>2</sup> These factors are inspiring political decisions to implement health system reforms, de-regulation and pro-competitive policies across health systems worldwide.<sup>3–5</sup>

To deal with these challenges, health system reforms have placed a greater emphasis on primary health care coverage, supported by multidisciplinary teams.<sup>6</sup> Most successful multidisciplinary chronic illness interventions include more significant roles for non-physicians, with studies showing that non-physician health professionals, such as community pharmacists, may be critical components of effective chronic disease care.<sup>7–9</sup> Community pharmacists are significantly contributing to primary health care by fulfilling an increasing range of roles and responsibilities.<sup>10,11</sup> These new roles stem from the origination of the concept of pharmaceutical care<sup>12</sup> over two decades ago. After this initial work, the profession developed numerous new services. These include services such as counseling about medicines and minor ailments, public education to promote public health, medication use review services, disease management services, immunization services, and several activities related to chronic diseases screening such as blood pressure, cholesterol, glycemia and lung capacity monitoring.<sup>13,14</sup>

Community pharmacies in Portugal have followed this general trend, with the provision of pharmaceutical care services supported and advocated by the country's main professional organizations.<sup>14</sup> However, a number of regulatory changes to the community pharmacy market were introduced in 2005, beginning with the extension of sales of over-the-counter (OTC) medicines to general shops beyond pharmacies, to the loss of pharmacists' exclusivity of propriety, and the possibility of a single proprietor to own a maximum number of 4 pharmacies.<sup>15</sup> These regulatory changes also expanded the provision of services to be offered by pharmacies, such as home care support, first aid, medicines administration, immunization (particularly for influenza flu shots), clinical analysis and therapeutic services. This new pro-competition market in which Portuguese community pharmacies presently operate, has brought a new necessity to gain a deeper understanding of costs for these new services, to gauge their potential impact on pharmacies' management.

One issue keeping policy makers from tapping into the potential of community pharmacists' interventions is the clear understanding of their

cost-effectiveness.<sup>16</sup> Although some studies point to the cost-effectiveness of pharmaceutical care programs and Pharmacy-based minor ailment schemes,<sup>8,17</sup> it is often mentioned that more research to determine the accurate costs of pharmaceutical services is needed,<sup>17,18</sup> to prevent inappropriate payment incentives, and to accomplish proper pharmacy services research.<sup>19</sup> Notwithstanding, there is a scarcity of costing studies for most types of pharmaceutical services. Some published studies on the profitability of pharmacy services tend to focus on single specific services over a limited period of time.<sup>20,21</sup> In a recent review of pharmacy-based minor ailment schemes' cost-effectiveness,<sup>17</sup> it was found that the majority of the published studies employed a classical top-down approach, sometimes apportioning consultation fees, medicine and administrative costs indiscriminately the cost computations, or had a less than straightforward method of cost calculation. In the case of Portugal, costing studies have focused predominantly on the financial sustainability of the pharmacy business. Recent local studies have drawn the attention on the decreasing average price of prescriptions as a measure of pharmacies' sustainability.<sup>22,23</sup> Therefore, this makes it difficult to draw wide-ranging conclusions on the impact of pharmaceutical services on pharmacy management and other health care resources, as well as on their cost-effectiveness.<sup>24</sup>

To better assess the management implications of pharmaceutical services provision in community pharmacies, there is a need to accurately measure costs through real-world evidence instead of assumptions and self-reported data. Considering that evidence is required to justify pharmacists' activities, the associated costs and assist community pharmacy management,<sup>25</sup> the aim of this work is to explore the development of a time-driven activity-based costing (TDABC) model for pharmaceutical services, with the objective of calculating services' costs, using a bottom-up approach. Accomplishing this objective will help to inform pharmacy managers, pharmacy professional organizations and policy makers about the costs of pharmaceutical services and their cost-effectiveness. Although this approach has been tried in outpatient clinics,<sup>26</sup> this is new to community pharmacy services' costing in Portugal or elsewhere. In the study by Demeere et al.,<sup>26</sup> the use of TDABC provided precise values of the costs of different consultations within five different departments, showing the influence of the specificity of the consultation or the usage of activities and

machinery. With this information, managers could design a set of recommendations to improve the business, from centralized clerical assistance, to voice recognition systems. It is therefore expected that the development of such a model for pharmaceutical services costing could provide community pharmacy's managers worldwide with information necessary to redesign activities to achieve a more cost-effective provision of these services.

## Methods

Within a health care context, approaches to estimating costs have been broadly categorized mainly into top-down and bottom-up categories. Top-down approaches use relative value units (RVUs), such as hospital days or some other metric to apportion the total costs for a health care system to individual services.<sup>19</sup> Bottom-up approaches such as activity-based costing (ABC), quantify the amount of each resource that is used to produce an individual health care service and apportion costs accordingly to generate aggregate costs for a health care system.<sup>19</sup> In spite of its advantages, it has been difficult for many organizations to implement ABC models for a number of reasons, ranging from the high costs of acquiring the necessary data to construct and update the ABC model, to the use of subjective and time allocation techniques that are costly to validate.<sup>27</sup> To overcome these complications, Kaplan and Anderson developed the time-driven activity-based costing (TDABC) approach, building on ABC concepts. Straightforwardness of implementation is TDABC's main advantage, as it requires estimates of only two parameters: (1) the unit cost of supplying capacity, and (2) the time required to perform transactions and activities.<sup>28</sup> It is important to note that this required estimate is not the total input time for each activity, but only the time spent doing one unit of the activity. The specific advantage of this method is that having measured the time consumed by the different activities necessary to provide a service, managers can then optimize the process improving the activities consuming the most time.<sup>29</sup>

### *Observational study methodology*

This study's approach to the TDABC methodology started with an exploratory observational time-and-motion (T&M) study using the shadowing method.<sup>30</sup> There are two common techniques

for collecting work activity information: work-sampling and T&M. Collecting information through work sampling implies that an inference is to be made to calculate the portion of overall work time spent on an activity, based on the percent of observations that relate to that activity. On the other hand, the T&M technique uses an observer to record exactly how much time is being devoted to each task.<sup>30</sup> The usefulness of time and motion studies in a community pharmacy setting has been praised in the literature.<sup>25,31–33</sup>

To accomplish the observational study, it was necessary to develop a list of activities to be observed. An initial list of activity categories was created by reviewing existing community pharmacy studies.<sup>32–34</sup> This list was then validated in one of the participant pharmacies, and subsequently minor adjustments were made. The main inclusion criteria for pharmacy participation were their location in the Lisbon metropolitan area and their willingness to participate in the study. Six pharmacies were contacted, and three pharmacies accepted to be included as participants.

The study took place on one weekday in 2012, during an 8 h shift, with a 2 h lunch break. The data collector – a community pharmacy specialist and trained observer – was free to observe and record all the staff's activities. An Excel<sup>®</sup> spreadsheet was developed to record a structured scheme for coding observations, which comprised the activity performed, the place within the pharmacy where the activity occurred, whom executed it and how much time did it take.

### *Ethical approval*

This study was carried out following the good research practices and code of ethics of Instituto de Higiene e Medicina Tropical, Universidade Nova de Lisboa. The study protocol was approved by the IHMT Ethics Committee (Permit Number: 7-2012-PN). Customers interacting with the pharmacy's professionals were informed about the study orally by the staff and gave their consent.

### *Services' processes*

Since time is the apportionment method in a TDABC model, the main outputs of interest for this study were the time spent performing a service and the activities required to carry out each service.

To start the TDABC approach, the services of interest had to be defined. Four types of services were expected:

- Prescription medicine dispensing – any pharmacist/customer interaction with a medicine dispensed following the presentation of a prescription.
- “Over-the-counter” (OTC) medicines dispensing – any pharmacist/customer interaction with an OTC dispensed without any more products.
- Counseling without dispensing – any pharmacist/customer interaction with no dispensing, just pharmacist counseling after a customer’s query.
- Health screening services – any pharmacist/customer interaction with the provision of a screening service such as blood pressure, glycaemia or cholesterol measurement.

To define each of these services, the sequence of main activities within each provision process was identified. [Table 1](#) details the activities necessary to service provision.

For proper analysis, each activity was considered as a cost centre, to which the direct costs and support resources were assigned. The relation

between the activities and the corresponding necessary resources is presented in [Table 2](#).

#### *Cost analysis*

After tracking direct costs to specific activities, it is possible to calculate the cost rate per activity by identifying both the expenditures attributable to the resource and the total available capacity for each resource.<sup>28</sup> The total available capacity of the resource was calculated considering 365 days of a year, subtracting weekends (104 days), mandatory holidays (9 days) and vacation days (22), totaling 19.17 days available per month. To calculate the available hours, an 8-h shift workday was considered and then subtracted the time registered as unused in the observation study, to obtain the available capacity of the resource.

The cost data were obtained from the pharmacies’ accountant sheets for the month of the observation. To calculate the cost rates for the different activities, direct costs and support resources were calculated as follows<sup>28</sup>:

Table 1  
Description of the activities necessary for service provision

Activities necessary for service provision	Description of activity	Services
Receive prescription/patient query	Each request made by the patient – either through a prescription or a self-reported health need – is considered as a service starting point.	Prescription medicine dispensing; OTC dispensing; counseling without dispensing; health screening services
Interview patient/answer patient query	A small interview follows, where the pharmacist asks questions that will guide the process. For the “counseling without dispensing” services, this is the final activity.	Prescription medicine dispensing; OTC dispensing; counseling without dispensing; health screening services
Validate and dispense prescription/OTC medicine	With the information collected in the previous activity, the pharmacist proceeds with the dispensing of the prescription/OTC medicine	Prescription medicine dispensing; OTC dispensing;
Perform service (for screening services)	Performing the technique necessary to provide the required screening service	Health screening services
Process prescription	Printing, in the back of the prescription, all the information necessary for reimbursement by the NHS	Prescription medicine dispensing;
Collect payment	End of transaction and patient interaction receiving a form of payment	Prescription medicine dispensing; OTC dispensing; health screening services
Re-check prescriptions	Re-checking the prescription after the transaction to check for dispensing or administrative errors. Usually made by a different professional or the supervisor	Prescription medicine dispensing;
Manage inventory and records	Checking for stock levels, ordering more medicines if required	Prescription medicine dispensing; OTC dispensing

Table 2  
Assignment of costs and support resources for each activity

Activities necessary for service provision	Costs and support resources										
	Salaries (including supervisor)	Work space	Storing space	Amortization and depreciation costs	Taxes	IT and communication	Stationary	Electricity/water	Laboratory equipment and supplies	Support costs	Other losses
Receive prescription/patient query	X	X	X	X				X		X	X
Interview patient/answer patient query	X	X		X		X		X		X	X
Validate and dispense prescription/OTC	X	X	X	X	X	X	X	X		X	X
Process prescription	X	X		X		X		X		X	X
Perform service	X	X		X	X	X		X	X	X	X
Collect payment	X	X		X	X	X		X		X	X
Re-check prescriptions	X	X		X		X	X	X		X	X
Manage inventory and records	X	X	X	X	X	X	X	X		X	X

- Salaries – includes the salary of the average pharmacist plus 10% of the technical director’s salary for supervision purposes;
- Working space – area where the activity takes place. Capital value per square meter obtained from the rent value;
- Storing space – total storage area. Value per square meter obtained from the rent value.
- Amortization and depreciation costs – estimated as a percentage of the annual business volume; it includes the amortization costs of buildings, equipment and depreciation costs of inventory<sup>22</sup>;
- Taxes – estimated sales taxes, calculated as a percentage of the annual business volume<sup>22</sup>;
- Information system (IS) and communications – include the monthly cost of IS renting and of communications costs, such as telephone, fax and internet;
- Stationary – include costs such as paper, printer ink, and other essential disposable office material;
- Electricity and water costs – include energy and water bills;
- Laboratory equipment and supplies – equipment cost rates based on their practical capacity, and cost of supplies such as gloves, lancets, test stripes, etc;
- Support costs – other support costs include in this case, cost of cleaning services and cost of security services;
- Other losses – estimated on a percentage of the annual business volume, including the cost of damaged medicines’ packages that had to be returned to the supplier.<sup>22</sup>

With all the activities’ cost rates calculated, it is now possible to find the cost of a specific service, using the following time equation:

$$\begin{aligned}
 \text{Service cost} &= (t_1 * \text{cost rate}_1) \\
 &+ (t_2 * \text{cost rate}_2) \\
 &+ (t_3 * \text{cost rate}_3) \\
 &+ (t_n * \text{cost rate}_n)
 \end{aligned}$$

All data analysis was conducted in Excel® and SPSS® (Software Package for Social Sciences; Version 20, IBM, Chicago, IL).

### Results

There were many pharmacist–customer interactions where ‘multitasking’ and provision of

more than one service was recorded. For the purpose of this work, only those tasks where provision of a single pharmaceutical service was offered were considered, to avoid double counting the time spent with a customer in simultaneous activities.

In one third of these interactions, prescription medicines were dispensed, which was the main pharmaceutical service observed in this case. The average times of service provision varied from pharmacy to pharmacy (Table 3).

For the dispensing service, the average duration considering all pharmacies was 4.41 min (23.9%–29.4% of pharmacist/customer interactions). For most of dispensing services (54.9%), a maximum of 2 medicine packages were dispensed.

The other most provided service was ‘counseling without dispensing’ (11.0%–15.7% of pharmacist/customer interactions – average time 2.31 min), followed by ‘OTC medicines sales’ (10.6%–13.9% of interactions – average time 2.55 min) and ‘screening services,’ which included tests of cholesterol levels, glycemia and blood pressure monitoring (2.1%–9.4% of interactions – average time 4.51 min). Chronic disease management, medicines use review or other medication management services were not observed in these pharmacies.

Identifying the time spent on each activity allowed the calculation of the cost per activity required for each service. Starting with the calculation of unused time per pharmacist, it was found that each pharmacist had a different number of available hours: 129.43 h per pharmacist in pharmacy A, 140.18 h per pharmacist in pharmacy B and 142.04 h per pharmacist for pharmacy C. A simplifying choice was made to consider this available capacity of resources equal for every cost centre, from human resources to space and equipment, since a pharmacy cannot operate without a pharmacist being present. This information allowed the calculation of the cost rate per activity (Table 4).

After this, it is now possible to calculate the total cost of the services using the time equation previously presented, where  $t_1$  is the time spent with the first activity and so forth (see Table 1 of Annex 1 for the detailed distribution of time and costs per activity). In Table 5, the calculated costs of each service are presented.

In general, the overall costs of services across the three pharmacies were very similar. For discussion purposes, an average cost for the three pharmacies was calculated, starting with the average cost for a dispensing service at €3.66. Excluding depreciation, amortization and taxes, this value drops to €2.12; OTC dispensing average cost was €2.16, or €1.30 excluding depreciation, amortization and taxes; for the counseling service, the average cost was €1.34 with all the costs included, or €0.87 excluding depreciation and duties; Health screening services’ average costs was €3.59, or €1.90 without the extra costs.

## Discussion

According to this TDABC analysis, dispensing appeared to be the most expensive service across the three pharmacies. Screening services were also found to represent a relevant cost for the outlets. It is important to highlight that these screening services are usually provided in a separate space of the pharmacy, of varying size, and using different materials, leading to considerable variation in its overall costs. By contrast, counseling without dispensing was found to represent a low-cost service. This cost could be considered as a marketing cost, whereas the pharmacist is both extending the relationship and getting information from the consumer.

When considering the costs for specific dispensing services, it is possible to estimate that for an average medicine dispensing process to be profitable, on average it has to cover costs of €3.66. In Portugal, pharmacy remuneration is nowadays defined by the Decree-Law 19/2014 of

Table 3  
Average time spent per service

Services	Pharmacy			Average times (all pharmacies)
	A (hh:mm:ss)	B (hh:mm:ss)	C (hh:mm:ss)	
Medicine dispensing	00:04:19	00:05:27	00:04:16	00:04:41
OTC medicine dispensed	00:02:20	00:02:22	00:04:02	00:02:55
Counseling w/out dispensing	00:02:45	00:02:19	00:02:30	00:02:31
Health screening services	00:04:26	00:04:03	00:06:03	00:04:51

Table 4  
Cost rates for the activity, per pharmacy

Activity	Cost rates Pharmacy A (€/hour)	Cost rates Pharmacy B (€/hour)	Cost rates Pharmacy C (€/hour)
Receive prescription/patient query	€28.19	€32.11	€25.97
Interview patient/answer patient query	€31.78	€34.05	€30.29
Validate and dispense prescription/OTC	€48.15	€53.52	€58.38
Process prescription	€32.16	€34.46	€30.99
Perform service	€38.94	€51.03	€46.46
Collect payment	€41.18	€48.36	€39.06
Re-check prescriptions	€28.57	€32.51	€26.67
Manage inventory and records	€48.15	€53.52	€58.38

February 5,<sup>35</sup> that building on the previous system of differential mark-up, introduced a fixed fee per medicine, aiming to achieve an average distribution of 80% fixed fee plus 20% of variable margin. Therefore, considering a 20% profit margin on overall medicine and OTC sales, any sale of €18.30 or less that lasts beyond the average time will be performed at a loss. Considering that the average price of a prescription in Portugal is €25.97,<sup>36</sup> the implication of this finding is that these three pharmacies seemed to be operating within the profit area and were managing to cover their costs for the average dispensing service. However, these are average numbers and thus should be interpreted with caution. Nowadays, 90% of prescription medicines reimbursed by the Portuguese NHS cost under 25 euros,<sup>36</sup> due to the changes in the external reference pricing and changes in the distribution (pharmacies' and wholesalers') margins.<sup>3</sup> One can argue that current policy options have placed great stress on

pharmacy management. This result adds to the strong evidence supporting the threat on pharmacies' sustainability,<sup>22,23</sup> since the implementation of the measures of "the Memorandum of Understanding," signed by the Portuguese Government, the European Commission (EC), the European Central Bank (ECB), and the International Monetary Fund (IMF) in 2011.

Evidence suggests that when patients feel that their symptoms are not serious enough to consult a doctor, they visit a pharmacy instead.<sup>17,18</sup> Some evidence from the UK shows that minor ailments (i.e. uncomplicated conditions that may be diagnosed without medical intervention) can be better managed through the use of community pharmacies as they are less costly than the option of visiting an emergency department (ED) or even general practice (GP).<sup>18</sup> In this study, an OTC consultation could cost as much as €2.97. This is much less than what a patient is expected to pay for a emergency visit to the GP or a ED,

Table 5  
Costs of services per pharmacy

Services	Pharmacy A	Pharmacy A <sup>a</sup>	Pharmacy B	Pharmacy B <sup>a</sup>	Pharmacy C	Pharmacy C <sup>a</sup>	Average	Average <sup>a</sup>
	Cost	Cost	Cost	Cost	Cost	Cost	Cost	Cost
Dispensing services	€3.16	€1.93	€4.29	€2.03	€3.52	€2.40	€3.66	€2.12
OTC medicine dispensed	€1.61	€1.00	€1.90	€0.89	€2.97	€2.03	€2.16	€1.30
Counseling without dispensing	€1.46	€1.01	€1.31	€0.73	€1.24	€0.86	€1.34	€0.87
Health screening services	€2.86	€1.48	€3.37	€1.45	€4.55	€2.78	€3.59	€1.90

<sup>a</sup> Costs of services excluding depreciation, amortization and taxes.

with those costing as much as €10.30 or €20.60, respectively, in user charges.<sup>37</sup> Currently, the lack of a formal referral protocol between community pharmacies and the remaining NHS services, similar to the minor ailment scheme in place in UK's NHS, hinders harvesting such potential savings for the patients. Policy makers may find in this work an initial starting point to evaluate the cost-effectiveness of such a scheme in the Portuguese health system.

On the costs of pharmacist counseling, it is difficult to compare the results here presented with those from different settings due to the cultural differences. However, estimates exist for the volume and value of the "Counseling service" for prescription medicines or OTC dispensing and for screening tests in Portugal.<sup>38</sup> In one study, the value of counseling was estimated to vary between €1.32 for counseling of prescription medicines, €1.44 for OTC counseling and €1.54 for counseling about screening services.<sup>38</sup> This research shows that the costs of counseling without dispensing are consistent with those from previous studies, which suggests that the cost of a counseling service is likely to range between €1.00 and €1.60 for many pharmacies in Portugal. This is a meaningful finding, since at the moment the costs of counseling services are not covered by any direct or NHS co-payment, although its payment is currently being discussed.<sup>39</sup>

For pharmacy managers, considering that pharmaceutical services without an associated sale are considerably less expensive, due to the absence of inventory costs, developing and sustaining new services focusing on medicine utilization, medicine use review or other pharmaceutical care services, should be promoted, since they can become an important source of revenue. However, even if these services were profitable, it is important to note that the service volume will only be a fraction of a full-time pharmacist's time and salary. Revenues from dispensing prescription medicines usually represent between 85% and 92% of overall pharmacy revenues.<sup>20,36</sup> It seems that the current cost structure and revenue flow contribute to turn dispensing services a vital part of a community pharmacy, as new services are being developed and become an established feature.<sup>20</sup> An argument could be made that focusing on the retail part of the profession should be promoted in times of economic uncertainty, especially if costs can be cut by reducing staffs' salaries; however, given the rapidly evolving roles of the profession, this approach may threaten the

very survival of community pharmacists as health professionals.<sup>40</sup>

One common challenge for pharmacists is establishing a price for the service that is both perceived as a good value by the patient and large enough to finance it.<sup>41</sup> Traditionally, pharmacists have provided these new services free of charge.<sup>42</sup> However, some payers have already recognized the value of pharmacist-provided immunizations and reimbursement of these services is commonplace in some countries.<sup>41</sup> With the development of a bottom-up costing model pharmacy managers may be able to define service fees more accurately, thus increasing their cost-effectiveness. This is of importance since the definition of the best remuneration model for pharmaceutical services is still a matter of debate within the profession and policy makers.<sup>16</sup>

The TDABC approach here explored, with its time-based calculations, offered some specific advantages over traditional costing models, chiefly because of its superior transparency in comparison to conventional cost-accounting methods. In this study, validation and dispensing of the prescription, together with managing of inventory and other records, were found to be the highest-cost activities. Since cutting salaries or storage space may not always be an available option, these findings suggest that managers could resort to automation of some part of the processes, applying information technologies to lower the time spent in some activities, leading to the reorganization of processes and the internal functioning of the pharmacy.

The inclusion in a cost management model of financial costs, such as amortization and depreciation as well as other type of overhead costs such as costs due to losses in material or taxes, has traditionally been considered problematic.<sup>43</sup> Health care organizations will always have to maintain inventories of essential items, and in the case of community pharmacies, this inventory is essential to the function they exert in the health system. Thus, this cost will always have to be included in the cost calculation of a medicine dispensing service. In this work, the two approaches were explored, calculating amortization and depreciation based on an estimation of annual business volume and including them in the calculation of capacity cost rates. This may not turn out to be the most accurate approach available, but allowed to explore the differences between inclusion and exclusion of these costs in the cost calculation of a health care service.



Nevertheless, one can argue that TDABC still needs to be completed with other cost analysis to allow more accurate costing of services involving medicine dispensing.

When performing an ABC analysis, the accuracy of cost driver rates from individuals' subjective estimates of their past or future behavior was called into question. The use of observational T&M studies to support TDABC analysis may be a way to overcome such bias. On the other hand, both T&M and work-sampling methods are vulnerable to error as workers may change their behavior when being observed, yielding unusually longer time spent per activity. The implication of this bias is that the costs here calculated should be viewed as maximum costs for these services in these pharmacies. However, a larger number of measurements of time allocated to specific activities may have strengthened the results. Also, the use of only three pharmacies may be considered a fragility of this study. In spite of this, the 3 pharmacies that accepted to participate are similar to a large portion of typical Portuguese pharmacies. A larger sample of pharmacies could provide a better insight of costs and pharmaceutical services provision, namely regarding services not observed like medication use reviews, immunization services or pharmaceutical care services; future research that do so will considerably improve the results here presented. Although this is an exploratory approach, it is expected that the results presented will provide key information for the work of community pharmacy managers, professionals and policy makers.

## Conclusion

This work explores the use of time-driven activity-based costing to analyze pharmaceutical services' cost structure providing information to improve management in a set of community pharmacies. From this analysis, most relevant service costs were obtained and analyzed.

The medicine dispensing service was found to be the most expensive in all three participating pharmacies. Another finding of relevance is that the costs of prescription dispensing are barely covered by the margins defined under current legislation. However, the costs of OTC dispensing and the costs of counseling without medicine dispensing shows that the implementation of minor ailment schemes in Portuguese pharmacies may be cost-effective, when compared with the

costs in users' charges in GP and ED of the Portuguese NHS.

This work shows that there is a clear opportunity for improving service management by optimizing dispensing, since this represents the most relevant cost. Also, the search for innovative low-cost pharmaceutical care services, which could secure additional revenue streams, should be promoted by corporate as well as independent pharmacy managers.

The remuneration of new pharmaceutical services is an open discussion that will be better informed if a solid body of evidence about the real costs is built. Professional organizations – key drivers for change in Portugal – should promote research on this topic. Developing a bottom-up costing model that allows identifying accurate costs may be an important tool for pharmacy managers for fixing service fees for future services as well as to inform the discussions about remuneration. It is expected that these findings will help inform managers, professionals and policy makers assessing new models of remuneration for pharmaceutical care services in Portugal and abroad. However, further studies covering a larger number of pharmacies and repeated time observations could help improve the rigor of future TDABC costing calculations.

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## Annex 1

Table 1  
Detailed times per activity and related costs in the three pharmacies

Services	Activity	Pharmacy A		Pharmacy B		Pharmacy C	
		Time (hh:mm:ss)	Costs (€)	Time (hh:mm:ss)	Costs (€)	Time (hh:mm:ss)	Costs (€)
Medicine dispensing	Receive prescription/patient query	00:00:13	0.10	00:00:16	0.15	00:00:13	0.09
	Interview patient/answer patient query	00:00:13	0.11	00:00:26	0.25	00:00:13	0.11
	Validate and dispense prescription/ OTC	00:02:22	1.91	00:02:44	2.43	00:02:08	2.08
	Process prescription	00:00:26	0.23	00:00:33	0.31	00:00:26	0.22
	Collect payment	00:00:14	0.16	00:00:16	0.22	00:00:20	0.22
	Re-check prescriptions	00:00:06	0.05	00:00:23	0.21	00:00:13	0.09
	Manage inventory and records	00:00:44	0.59	00:00:49	0.73	00:00:44	0.71
	<b>Total</b>	<b>0:04:19</b>	<b>3.16</b>	<b>0:05:27</b>	<b>4.29</b>	<b>0:04:16</b>	<b>3.52</b>
OTC medicine dispensed	Receive prescription/patient query	00:00:25	0.22	00:00:10	0.09	00:00:36	0.26
	Interview patient/answer patient query	00:00:28	0.25	00:00:26	0.25	00:01:13	0.61
	OTC counseling and dispensing	00:01:03	0.84	00:01:25	1.27	00:01:37	1.57
	Collect payment	00:00:10	0.11	00:00:06	0.09	00:00:12	0.13
	Manage inventory and records	00:00:14	0.19	00:00:14	0.21	00:00:24	0.39
	<b>Total</b>	<b>0:02:20</b>	<b>1.61</b>	<b>0:02:22</b>	<b>1.90</b>	<b>0:04:02</b>	<b>2.97</b>
Counseling w/out dispensing	Receive patient query	00:00:33	0.29	00:00:14	0.12	00:00:15	0.11
	Interview patient/answer patient query	00:02:12	1.17	00:02:05	1.18	00:02:15	1.14
	<b>Total</b>	<b>0:02:45</b>	<b>1.46</b>	<b>0:02:19</b>	<b>1.31</b>	<b>0:02:30</b>	<b>1.24</b>
Health screening services (example for glycemia monitoring)	Receive prescription/patient query	00:00:13	0.12	00:00:12	0.11	00:00:18	0.13
	Perform service	00:03:59	2.59	00:03:39	3.10	00:05:27	4.22
	Collect payment	00:00:13	0.15	00:00:12	0.16	00:00:18	0.20
	<b>Total</b>	<b>0:04:26</b>	<b>2.86</b>	<b>0:04:03</b>	<b>3.37</b>	<b>0:06:03</b>	<b>4.55</b>