The Economic Outcomes of Pharmacist Interventions at Critical Care Services of Private Hospital in Riyadh City, Saudi Arabia

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ABSTRACT

Objectives: The study aims to explore the economic outcomes of the clinical pharmacist at critical care units at a private hospital in Riyadh city, Saudi Arabia in a 6 months study and prevent additional medication costs. Methods: It was a 6-months cross-sectional study from January to June 2016 in adults critical care unit. It was a thirty-bed critical care bed consisting of trauma, medical, surgical and maternity critical care cases. The pharmacist monitored all patients through daily medical round and documents any pharmacist intervention. The pharmacist intervention system used an international study model, measure level of activity, rational of clinical intervention, recommendation, patient outcome and pharmacoeconomic impact related estimated cost avoidance. Results: The total number of pharmacist interventions were (1,222) provided to (1,124) patients. The complete cost avoidance from pharmacist intervention over the study period was (220,882.10 UD) while over one year was (441,764.2 USD). The highest cost avoidance of critical care interventions was from potentially significant 5.10% (102,581.78 USD) and potentially serious 32.28% (99,162.29 USD). The majority of cost avoidance came from anti-infective agents (73,408.95 USD) followed by nutrition and blood agents (61,182.97 USD) and cardiovascular medications (27,584.52 USD). The most rational clinical activities cost avoidance was from others type (102,168.44 USD) followed by inappropriate dose (30,504.16 USD) and TPN consultations (25,313.99 USD). The most patient outcome related to cost avoidance was patient condition improved (120,036.38 USD) followed by unknown outcomes (47,067.85 USD) and laboratory values improved (21,661.55 USD). The most pharmacoeconomic cost avoidance impact was a reduction in the cost drug therapy 79.94% (163,747.96 USD) and the patient length of hospital stay decreased 1.15% (32,846.49 USD). Conclusion: The critical care clinical pharmacist prevent the additional cost of drug-related problems occurrences and economic burden on the healthcare system at a private hospital in the Kingdom of Saudi Arabia. Expanding clinical pharmacist at critical care services is highly recommended to all private hospitals in Saudi Arabia. Key words: Economic outcomes, Pharmacist, Interventions, Critical care services, Private hospital, Riyadh, Saudi Arabia.

INTRODUCTION

In the past several years during pharmacy strategic plan at the Ministry of Health (MOH) in Saudi Arabia.1 There were several pharmacy practice programs established.2 There were several measures tools to follow up the programs and measure clinical outcomes and cost avoidance in pharmacy and healthcare system.1 Several previous studies across the world showed the reduction of the economic burden and save cost through pharmacist interventions with an emphasis on critical care services.3–7 The pharmacist can prevent medications errors and reduce adverse drug reactions and consequences the cost avoidance.5,6 Besides, the current site country conducted several investigations about the economic impact of the pharmacist at clinical services. They showed with drug information services, total parental nutrition services, critical care services, poisoning services.6,11 The majority of the studies done at the governmental hospital. It is hard to find a study conducted at private institutions.12 The aim of the study is to explore the economic outcome of pharmacist interventions at critical care department at the most prominent private hospital in Riyadh city, Saudi Arabia.

METHODS

It was a prospective cohort analysis from January to June 2016 in adults critical care unit. It was a thirty-bed critical care unit that consisted of trauma, medical, surgical and maternity critical care cases. Dr. Sulaiman Al-Habib Medical Group (HMG) is one of the largest healthcare providers in the Gulf Cooperation Council (GCC) Countries; currently there are 14 medical which are located in Saudi Arabia (Riyadh and Qassim) and in the UAE (Dubai). HMG is also developing one of the largest private medical cities in Saudi Arabia. In 1995, the core of the Medical Group of Dr. Sulaiman Al Habib was built in Olya area in the Saudi capital, Riyadh, with accordance to an advanced vision that applies the highest international healthcare standards; in providing fully integrated premium health services with a capacity of 241 beds. Furthermore, the complex comprises premium hospitals and clinics of fully integrated maternity hospital, bone, joint and spine surgery hospital, dermatology and plastic surgery centre, ophthalmology and laser/vision correction surgical centre, specialized infertility treatment and reproduction assistance centre. The pharmacies of HMG apply the new technological methods at all work.
phases. HMC Pharmacies have 4 in-patient pharmacy satellites and 3 outpatient pharmacies including the main. Pharmacies work 24/7 with an integrated team of 97 pharmacists with multiple specialities. The pharmacy’s work depends on the patient’s medical record system as it helps the pharmacist to provide greater care and protection against the conflict between medicines, especially concerning chronic diseases. The pharmacist monitored all patients through daily medical round and documents any pharmacist intervention. The pharmacist intervention system used an international study model, measure level of activity, rational of clinical intervention, recommendation, patient outcome and pharmacoeconomic impact. The estimated cost avoidance of prevents drug-related problems. The data was gathered and analyzed using the Monkey survey system.

RESULTS

The total number of pharmacist interventions were (1,222) provided to (1,124) patients. Of those 682 (44.19%) was male, 682 (55.81%) was female, the majority of patients were Saudi 956 (78.23%). The most patients in aged 65 years and above was 459 (37.59%) followed by age (18-40) was 368 (30.14%) and age (40-65) 263 (21.54%) (Table 1). The total cost avoidance from pharmacist intervention over the study period was (220,882.10 USD) while over one year was (441,764.2 USD). The cost avoidance during the study period was from female related was 44.41% (99,236.14 USD) while male avoidance cost was 55.59% (121,645.96 USD). Nationality related cost avoidance was 79.27% (195,711.07 USD) of saudi patients while 20.73% (25,171.03 USD) of non-saudi patients. The highest cost avoidance age was age over 65 years was 37.38% (90,630.48 USD), followed by age (16-40) was 30.59% (41,693.28 USD) and age (40-65 years) was 20.46% (28,607.03 USD) (Table 2-4). The most cost avoidance came from senior registrar prescriber 32.09% (273,796.51 USD) and age (40-65 years) was 30.59% (41,693.28 USD). The data was gathered and analyzed using the Monkey survey system.

Table 1: Patient demographic information.

| Age       | Answer Options | Response Count | Response Percent |
|-----------|----------------|----------------|------------------|
| 0-30 days | 36             | 2.95%          |
| 1 month-6 years | 56         | 4.59%          |
| 6-12 years | 17            | 1.39%          |
| 12-18 years | 22           | 1.80%          |
| 18-40 years | 368           | 30.14%         |
| 40-65 years | 263           | 21.54%         |
| 65 or older | 459           | 37.59%         |

Table 2: Gender VS cost avoidance.

| Sex       | Female | Male | Total |
|-----------|--------|------|-------|
| No | Cost  | No | % | Cost avoidance | No | % | Cost avoidance | No | % | Cost avoidance |
| 1a | 26.17 | 5 | 62.50 | 130.85 | 3 | 37.50 | 78.51 | 8 | 0.00 | 209.36 |
| 1b | 54.89 | 9 | 28.13 | 494.01 | 23 | 71.88 | 1,262.47 | 32 | 0.00 | 1,756.48 |
| 2a | 30.35 | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 |
| 2b | 30.35 | 67 | 53.60 | 2,033.45 | 58 | 46.40 | 1,760.30 | 125 | 0.00 | 3,793.75 |
| 2c | 30.35 | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 |
| 2d | 30.35 | 172 | 50.43 | 5,311.25 | 172 | 49.57 | 3,220.20 | 347 | 1.96 | 10,331.45 |
| 2e | 30.35 | 24 | 53.33 | 637.35 | 24 | 53.33 | 728.40 | 45 | 0.00 | 1,365.75 |
| 2f | 34.31 | 2 | 2.95 | 68.62 | 1 | 33.33 | 34.31 | 3 | 0.00 | 102.93 |
| 3a | 260.46 | 159 | 36.72 | 41,413.14 | 274 | 63.28 | 71,366.04 | 433 | 5.10 | 112,779.18 |
| 3b | 109 | 9 | 37.50 | 981.00 | 15 | 62.50 | 1,635.00 | 24 | 4.71 | 2,616.00 |
| 3c | 320.7 | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 | 0 | 2.75 | 0.00 |
| 4a | 370.04 | 5 | 83.33 | 1,850.20 | 1 | 16.67 | 370.04 | 6 | 54.90 | 2,220.24 |
| 4b | 581.75 | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 | 0 | 1.57 | 0.00 |
| 4c | 3,562.79 | 13 | 54.17 | 46,316.27 | 11 | 45.83 | 39,190.69 | 24 | 5.88 | 85,506.96 |
| 4d | 6,437.13 | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 | 0 | 6.67 | 0.00 |
| 5a | 6,592.03 | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 | 0 | 7.45 | 0.00 |
| 5b | 9,466.36 | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 | 0 | 7.06 | 0.00 |
| 5c | 11,837.51 | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 | 0 | 1.96 | 0.00 |
| 6 | 100,000.00 | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 | 0 | 0.00 | 0.00 |
| Total | 465 | 44.41 | 99,236.14 | 582 | 55.59 | 121,645.96 | 1047 | 100.00 | 220,882.10 |

Answered 1047, Skipped 175
USD) and consultant prescriber 63.61% (180,463.62 USD). The highest cost avoidance of critical care interventions was from potentially significant 51.00% (102,581.78 USD) and potentially serious 32.28% (99,162.29 USD) (Table 5 and 6). The majority of cost avoidance came from anti-infective agents (73,408.95 USD) followed by nutrition and blood agents (61,182.97 USD) and cardiovascular medications (27,584.52 USD) (Table 7). The most rational clinical activities cost avoidance was from others type (102,168.44 USD) followed by inappropriate dose (30,504.16 USD) and TPN consultations (25,313.99 USD). While the most pharmacist recommendations type related to cost avoidance was change dose (65,599.18 USD) followed by other recommendations (43,624.15 USD) and discontinuation (37,896.28 USD) (Table 8 and 9). The majority of cost avoidance came from anti-infective agent, nutrition product and cardiovascular medications.

The findings showed high-cost avoidance from elderly patients that’s related newly established of clinical pharmacy services at Riyadh city wish to measure the economic outcome of critical care pharmacy services. That almost similar what report by Aljbouri TM13 and MacLaren, R et al. in reduction infection-related problems,6 but higher than what reported by Schumock GT et al. that’s related newly established of clinical pharmacy services at current site and the different times between two studies with incremental cost.7 However, it is lower cost avoidance what reported by MacLaren R et al. with cardiologic diseases.7 There are not any differences in the cost avoidance among gender because both of them received the same service without differences in the numbers. The majority of cost avoidance related to Saudi patient because most of the patients were Saudi. The findings showed high-cost avoidance from elderly patients that’s would be excepted because the geriatrics had several diseases and needed medications and may be exposed to several mistakes and demand for close monitoring for prevention of them. Most of the cost avoidance as results from senior registrar prescriber more than consultant one. That is related to lower level of credential need more education and training related drug therapy. The highest cost avoidance of medications was from anti-infective agent, nutrition product and cardiovascular medications.

DISCUSSION

Many pharmacy practice programs founded during Pharmacy strategic plan.13,15 That has included drug information services, medication safety program, pain management program, stewardship antimicrobial program and critical care program programs.15-19 All those programs need to measure the impact and validate the cost requirement. The pharmacy administration at the ministry of health released key performance indicators to follow up and measure the clinical and economic impact of the program. The pharmacy strategic plan started implementation at private hospitals. Authors working at the most prominent private hospital in Riyadh city wish to measure the economic outcome of critical care pharmacy services. The findings should very high cost avoidance as the impact of pharmacist intervention at critical care services. That almost similar what report by Aljbouri TM13 and MacLaren, R et al. in reduction infection-related problems,6 but higher than what reported by Schumock GT et al. that’s related newly established of clinical pharmacy services at current site and the different times between two studies with incremental cost.7 However, it is lower cost avoidance what reported by MacLaren R et al. with cardiologic diseases.7 There are not any differences in the cost avoidance among gender because both of them received the same service without differences in the numbers. The majority of cost avoidance related to Saudi patient because most of the patients were Saudi. The findings showed high-cost avoidance from elderly patients that’s would be excepted because the geriatrics had several diseases and needed medications and may be exposed to several mistakes and demand for close monitoring for prevention of them. Most of the cost avoidance as results from senior registrar prescriber more than consultant one. That is related to lower level of credential need more education and training related drug therapy. The highest cost avoidance of medications was from anti-infective agent, nutrition product and cardiovascular medications.
Table 4: Age distribution vs cost avoidance.

| Sex   | 0-30 days | 1 month - 6 years | 6-12 years | 12-18 years | 18-40 years | 40-65 years | 65 or older | Total |
|-------|-----------|------------------|------------|-------------|-------------|-------------|-------------|-------|
| No    | No        | %                | Cost       | No          | %           | Cost        | No          | %    |
|       |           |                  | avoidance  |             |             | avoidance   |             |      |
| 1a    | 0         | 0.00%            | 0.00       | 0           | 0.00%       | 0.00        | 0           | 0.00% |
| 1b    | 0         | 0.00%            | 0.00       | 0           | 0.00%       | 0.00        | 0           | 0.00% |
| 2a    | 0         | 0.00%            | 0.00       | 0           | 0.00%       | 0.00        | 0           | 0.00% |
| 2b    | 4         | 3.20%            | 121.40     | 6           | 4.80%       | 182.10      | 6           | 4.80% |
| 2c    | 0         | 0.00%            | 0.00       | 0           | 0.00%       | 0.00        | 0           | 0.00% |
| 2d    | 3         | 0.87%            | 91.05      | 33          | 9.54%       | 1,001.55    | 7           | 2.02% |
| 2e    | 2         | 4.44%            | 60.70      | 0           | 0.00%       | 0.00        | 0           | 0.00% |
| 2f    | 0         | 0.00%            | 0.00       | 0           | 0.00%       | 0.00        | 0           | 0.00% |
| 3a    | 12        | 2.77%            | 3,125.52   | 6           | 1.39%       | 1,562.76    | 1           | 0.23% |
| 3b    | 1         | 4.17%            | 109.00     | 3           | 12.50%      | 327.00      | 2           | 8.33% |
| 3c    | 0         | 0.00%            | 0.00       | 0           | 0.00%       | 0.00        | 0           | 0.00% |
| 3d    | 0         | 0.00%            | 0.00       | 0           | 0.00%       | 0.00        | 0           | 0.00% |
| 4a    | 0         | 0.00%            | 0.00       | 1           | 16.67%      | 370.04      | 0           | 0.00% |
| 4b    | 0         | 0.00%            | 0.00       | 0           | 0.00%       | 0.00        | 0           | 0.00% |
| 4c    | 13        | 54.17%           | 46,316.27  | 1           | 4.17%       | 3,562.79    | 0           | 0.00% |
| 4d    | 0         | 0.00%            | 0.00       | 0           | 0.00%       | 0.00        | 0           | 0.00% |
| 5a    | 0         | 0.00%            | 0.00       | 0           | 0.00%       | 0.00        | 0           | 0.00% |
| 5b    | 0         | 0.00%            | 0.00       | 0           | 0.00%       | 0.00        | 0           | 0.00% |
| 5c    | 0         | 0.00%            | 0.00       | 0           | 0.00%       | 0.00        | 0           | 0.00% |
| 6     | 0         | 0.00%            | 0.00       | 0           | 0.00%       | 0.00        | 0           | 0.00% |
| Total | 35        | 33.33%           | 49,823.94  | 50          | 4.78%       | 7,006.24    | 15          | 1.43% |
|       |           |                  |            |             |             |             |             |       |

Answered questions 1047, Skipped questions 175
Table 5: Prescriber qualifications VS cost avoidance.

| Sex | Consultant | Serier registrar | Registrar | Intern | Total |
|-----|------------|-----------------|-----------|--------|-------|
| No  | Cost       | No   | %    | Cost avoidance | No | %    | Cost avoidance | No | %    | Cost avoidance | No | %    | Cost avoidance |
| 1a  | 26.17      | 8    | 100.00% | 209.36 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 8 | 0.76% | 209.36 |
| 1b  | 54.89      | 26   | 81.25% | 1,427.14 | 0 | 0.00% | 0.00 | 6 | 18.75% | 0.00 | 32 | 3.06% | 1,756.48 |
| 2a  | 30.35      | 0    | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 |
| 2b  | 30.35      | 43   | 34.40% | 1,305.05 | 9 | 7.20% | 273.15 | 73 | 58.40% | 19,939.95 | 125 | 11.94% | 3,793.75 |
| 2c  | 30.35      | 0    | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 |
| 2d  | 30.35      | 170  | 48.99% | 5,159.50 | 21 | 6.05% | 637.35 | 156 | 44.96% | 99,426.60 | 347 | 11.94% | 102,931 |
| 2e  | 30.35      | 16   | 35.56% | 485.60 | 5 | 11.11% | 150.75 | 24 | 53.33% | 3,642.00 | 45 | 4.30% | 1,365.75 |
| 3a  | 260.46     | 360  | 83.14% | 93,765.60 | 9 | 2.08% | 2,344.14 | 64 | 14.78% | 150,024.96 | 433 | 41.36% | 112,779.18 |
| 3b  | 109        | 16   | 66.67% | 1,744.00 | 1 | 4.17% | 109.00 | 7 | 29.17% | 763.00 | 24 | 2.29% | 2,616.00 |
| 3c  | 320.7      | 0    | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 |
| 4a  | 370.04     | 4    | 66.67% | 1,480.16 | 0 | 0.00% | 0.00 | 2 | 33.33% | 0.00 | 6 | 0.57% | 2,220.24 |
| 4b  | 581.75     | 0    | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 |
| 4c  | 3,562.79   | 21   | 87.50% | 74,818.59 | 0 | 0.00% | 0.00 | 3 | 12.50% | 24 | 2.29% | 85,506.96 |
| 4d  | 6,437.13   | 0    | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 |
| 5a  | 6,592.03   | 0    | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 |
| 5b  | 9,466.36   | 0    | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 |
| 5c  | 11,837.51  | 0    | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 |
| 6   | 100,000.00 | 0    | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 |
| Total | 666   | 63.61% | 180,463.62 | 45 | 4.30% | 3,515.39 | 336 | 32.09% | 273,796.51 | 1047 | 100.00% | 220,882.10 |

Answered 1047, Skipped 175
### Table 6: Intervention severity VS cost avoidance.

| Sex | Potentially Fatal | Potentially Serious | Potentially Significant | Neutral | Total |
|-----|------------------|---------------------|------------------------|---------|-------|
|     | Cost % | Cost % | Cost % | Cost % | Cost % | Cost % | Cost % | Cost % | Cost % | Cost % | Cost % | Cost % |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 1a  | 26.17 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 8 | 100.00% | 209.36 | 0 | 0.00% | 0.00 | 8 | 0.00% | 209.36 |
| 1b  | 54.89 | 0 | 0.00% | 0.00 | 4 | 12.50% | 219.56 | 28 | 87.50% | 1,536.92 | 0 | 0.00% | 0.00 | 32 | 0.00% | 1,756.48 |
| 2a  | 30.35 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 |
| 2b  | 30.35 | 0 | 0.00% | 0.00 | 7 | 5.60% | 212.45 | 106 | 84.80% | 3,217.10 | 12 | 9.60% | 364.20 | 125 | 0.00% | 3,793.75 |
| 2c  | 30.35 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 |
| 2d  | 30.35 | 0 | 0.00% | 0.00 | 24 | 6.92% | 728.40 | 212 | 61.10% | 6,434.20 | 111 | 31.99% | 3,368.85 | 347 | 1.96% | 10,531.45 |
| 2e  | 30.35 | 0 | 0.00% | 0.00 | 7 | 5.60% | 212.45 | 106 | 84.80% | 3,217.10 | 12 | 9.60% | 364.20 | 125 | 0.00% | 3,793.75 |
| 2f  | 34.31 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 |
| 3a  | 260.46 | 2 | 0.46% | 520.92 | 287 | 66.28% | 74,752.02 | 132 | 30.48% | 74,752.02 | 12 | 2.77% | 3,125.52 | 433 | 5.10% | 112,779.18 |
| 3b  | 109 | 0 | 0.00% | 0.00 | 7 | 29.17% | 763.00 | 17 | 70.83% | 1,853.00 | 0 | 0.00% | 0.00 | 24 | 4.71% | 2,616.00 |
| 3c  | 320.7 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 |
| 4a  | 370.04 | 0 | 0.00% | 0.00 | 3 | 50.00% | 1,110.12 | 3 | 50.00% | 1,110.12 | 0 | 0.00% | 0.00 | 6 | 54.90% | 2,220.24 |
| 3d  | 581.75 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 |
| 4c  | 3,562.79 | 1 | 4.17% | 3,562.79 | 6 | 25.00% | 21,376.74 | 15 | 62.50% | 53,441.85 | 2 | 8.33% | 7,125.58 | 24 | 5.88% | 85,506.96 |
| 4d  | 6,437.13 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 |
| 5a  | 6,592.03 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 |
| 5b  | 9,466.36 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 |
| 5c  | 11,837.51 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 |
| 6   | 100,000.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 |
| Total | 3 | 0.29% | 4,083.71 | 338 | 32.28% | 99,162.29 | 534 | 51.00% | 102,581.78 | 172 | 16.43% | 15,054.32 | 1047 | 100.00% | 220,882.10 |

Answered 1047, Skipped 175
Table 7: Pharmacological groups of interventions vs cost avoidance.

| Pharmacological Group                  | a       | b       | c       | d       | e       | f       |
|---------------------------------------|---------|---------|---------|---------|---------|---------|
| **Total**                             | 209.36  | 3,793.75| 1,365.75| 121.4   | 0       | 102.93  |
| **Eye disorder**                      | 0       | 0       | 0       | 0       | 0       | 0       |
| **Ear, Nose and Oropharynx**          | 0       | 0       | 0       | 0       | 0       | 0       |
| **Skin disorders**                    | 0       | 0       | 0       | 0       | 0       | 0       |
| **Anaesthesia**                       | 0       | 0       | 0       | 0       | 0       | 0       |
| **Other**                             | 0       | 0       | 0       | 0       | 0       | 0       |
| **Total**                             | 209.36  | 3,793.75| 1,365.75| 121.4   | 0       | 102.93  |

Answered questions: 1047, Skipped questions: 75

Sex:
- Male: 61,182.97
- Female: 2,220,282.10
Table 8: Clinical activities VS cost avoidance.

| Types               | Pharmacokinetic consult | Adverse drug reaction | Therapeutic Duplication | Alternative Therapy | Dose Standardization | Contraindication | Dosage Calculation | Inappropriate Dose | Inappropriate Route | Inappropriate Schedule | Incompatibility | Drug-Drug Interaction | Abnormal lab Test Result | Drug Therapy Omission | TPN Consultation | Other | Total |
|---------------------|-------------------------|-----------------------|-------------------------|---------------------|----------------------|-------------------|-------------------|-------------------|-------------------|----------------------|----------------|-----------------------|--------------------------|-----------------------|----------------|-------|-------|
| 1a                  | 0                       | 0                     | 0                       | 0                   | 0                    | 0                 | 0                 | 0                 | 0                 | 0                    | 0              | 0                     | 0                        | 0                     | 0              | 0     | 209.36|
| 1b                  | 0                       | 54.89                 | 0                       | 0                   | 0                    | 0                 | 0                 | 0                 | 0                 | 0                    | 0              | 0                     | 0                        | 0                     | 0              | 0     | 1,427.14|
| 2a                  | 0                       | 0                     | 0                       | 0                   | 0                    | 0                 | 0                 | 0                 | 0                 | 0                    | 0              | 0                     | 0                        | 0                     | 0              | 0     | 1,756.48|
| 2b                  | 0                       | 0                     | 30.35                   | 30.35               | 30.35                | 0                 | 0                 | 0                 | 0                 | 0                    | 0              | 0                     | 0                        | 0                     | 0              | 0     | 3,793.75|
| 2c                  | 0                       | 0                     | 0                       | 0                   | 0                    | 0                 | 0                 | 0                 | 0                 | 0                    | 0              | 0                     | 0                        | 0                     | 0              | 0     | 0     |
| 2d                  | 0                       | 0                     | 394.55                  | 5,887.90            | 60.7                 | 1,547.85          | 0                 | 0                 | 0                 | 0                    | 0              | 30.35                 | 0                        | 0                     | 0              | 0     | 455.25|
| 2e                  | 0                       | 0                     | 91.05                   | 0                   | 0                    | 0                 | 971.2             | 0                 | 0                 | 0                    | 0              | 273.15                | 0                        | 0                     | 0              | 0     | 3,793.75|
| 2f                  | 0                       | 0                     | 0                       | 0                   | 0                    | 0                 | 0                 | 0                 | 0                 | 0                    | 0              | 0                     | 0                        | 0                     | 0              | 0     | 0     |
| 3a                  | 0                       | 1,302.30              | 4,427.82                | 2,344.14            | 1,302.30             | 1,562.76          | 6,771.96          | 7,813.80          | 1,562.76          | 520.92               | 5,209.20        | 6,511.50              | 260.46                   | 3,906.90              | 65,115.00       | 112,779.18|
| 3b                  | 4,167.36                | 0                     | 109                     | 109                 | 0                    | 0                 | 109               | 0                 | 0                 | 0                    | 0              | 1,853.00              | 218                      | 218                 | 0              | 0     | 2616.00|
| 3c                  | 0                       | 0                     | 0                       | 0                   | 0                    | 0                 | 0                 | 0                 | 0                 | 0                    | 0              | 0                     | 0                        | 0                     | 0              | 0     | 0     |
| 4a                  | 0                       | 0                     | 740.08                  | 0                   | 0                    | 0                 | 0                 | 0                 | 0                 | 0                    | 740.08          | 0                     | 0                        | 0                     | 0              | 0     | 2,220.24|
| 4b                  | 0                       | 0                     | 0                       | 0                   | 0                    | 0                 | 0                 | 0                 | 0                 | 0                    | 0              | 0                     | 0                        | 0                     | 0              | 0     | 0     |
| 4c                  | 3,562.79                | 0                     | 0                       | 0                   | 0                    | 0                 | 17,813.95         | 0                 | 10,688.37         | 0                    | 0              | 0                     | 0                        | 0                     | 0              | 0     | 85,506.96|
| 4d                  | 0                       | 0                     | 0                       | 0                   | 0                    | 0                 | 0                 | 0                 | 0                 | 0                    | 0              | 0                     | 0                        | 0                     | 0              | 0     | 0     |
| 5a                  | 0                       | 0                     | 0                       | 0                   | 0                    | 0                 | 0                 | 0                 | 0                 | 0                    | 0              | 0                     | 0                        | 0                     | 0              | 0     | 0     |
| 5b                  | 0                       | 0                     | 0                       | 0                   | 0                    | 0                 | 0                 | 0                 | 0                 | 0                    | 0              | 0                     | 0                        | 0                     | 0              | 0     | 0     |
| 5c                  | 0                       | 0                     | 0                       | 0                   | 0                    | 0                 | 0                 | 0                 | 0                 | 0                    | 0              | 0                     | 0                        | 0                     | 0              | 0     | 0     |
| 6                   | 0                       | 0                     | 0                       | 0                   | 0                    | 0                 | 0                 | 0                 | 0                 | 0                    | 0              | 0                     | 0                        | 0                     | 0              | 0     | 0     |
| Total               | 3,562.79                | 4,277.14              | 5,896.83                | 4,853.24            | 4,347.24             | 1,411.30          | 1,957.31          | 30,504.16         | 8,948.63          | 13,962.87            | 520.92          | 6,167.28              | 6,729.50                  | 260.46                | 25,313.99       | 102,168.44  |

Answered questions 1047, Skipped questions 175
Table 9: Order changed based upon Pharmacists recommendation vs cost avoidance.

| Sex | Drug Discontinued | Change Drug | Drug Added | Dose Changed | Schedule Changed | Route Changed | Additional Lab Test Ordered | Unknown | Others | Total |
|-----|-------------------|-------------|------------|--------------|-----------------|---------------|----------------------------|---------|--------|-------|
| No  | No                | Cost avoidance | No          | Cost avoidance | No                | Cost avoidance | No                  | Cost avoidance | No        | No                | Cost avoidance | No          | Cost avoidance | Answered | Skipped |
| 1a  | 1                 | 26.17        | 0          | 0.00         | 0                | 0.00          | 0                   | 0.00        | 0                        | 7        | 183.19          | 8                | 209.36      |
| 1b  | 9                 | 494.01       | 4          | 219.56       | 1                | 54.89         | 1                   | 54.89        | 0                        | 16       | 878.24          | 32               | 1,756.48    |
| 2a  | 0                 | 0.00         | 0          | 0.00         | 0                | 0.00          | 0                   | 0.00         | 0                        | 0        | 0.00            | 0                | 0.00        |
| 2b  | 122               | 3,702.70     | 0          | 0.00         | 2                | 60.70         | 0                   | 0.00         | 0                        | 1        | 30.35           | 125               | 3,793.75    |
| 2c  | 0                 | 0.00         | 0          | 0.00         | 0                | 0.00          | 0                   | 0.00         | 0                        | 0        | 0.00            | 0                | 0.00        |
| 2d  | 8                 | 242.80       | 2          | 60.70        | 4                | 121.40        | 261                 | 7,921.35     | 51                       | 19       | 576.65          | 347               | 10,531.45   |
| 2e  | 1                 | 30.35        | 6          | 182.10       | 0                | 0.00          | 1                   | 30.35        | 18                           | 6        | 182.10          | 45               | 1,365.75    |
| 2f  | 0                 | 0.00         | 0          | 0.00         | 0                | 0.00          | 0                   | 0.00         | 3                        | 102.93   | 0.00            | 0                | 0.00        |
| 3a  | 57                | 14,846.22    | 31         | 8,074.26     | 76               | 19,794.96     | 70                   | 18,232.20    | 34                       | 343      | 112,779.18      | 433               | 112,779.18  |
| 3b  | 0                 | 0.00         | 2          | 218.00       | 3                | 327.00        | 1                   | 109.00       | 1                         | 10       | 1,090.00        | 24               | 2,616.00    |
| 3c  | 0                 | 0.00         | 0          | 0.00         | 0                | 0.00          | 0                   | 0.00         | 0                        | 0        | 0.00            | 0                | 0.00        |
| 4a  | 2                 | 740.08       | 0          | 0.00         | 1                | 370.04        | 0                   | 0.00         | 0                        | 1        | 370.04          | 2                | 2,220.24    |
| 4b  | 0                 | 0.00         | 0          | 0.00         | 0                | 0.00          | 0                   | 0.00         | 0                        | 0        | 0.00            | 0                | 0.00        |
| 4c  | 5                 | 17,813.95    | 0          | 0.00         | 3                | 10,688.37     | 11                   | 39,190.69    | 10                       | 2        | 7,125.58        | 24               | 85,506.96   |
| 4d  | 0                 | 0.00         | 0          | 0.00         | 0                | 0.00          | 0                   | 0.00         | 0                        | 0        | 0.00            | 0                | 0.00        |
| 5a  | 0                 | 0.00         | 0          | 0.00         | 0                | 0.00          | 0                   | 0.00         | 0                        | 0        | 0.00            | 0                | 0.00        |
| 5b  | 0                 | 0.00         | 0          | 0.00         | 0                | 0.00          | 0                   | 0.00         | 0                        | 0        | 0.00            | 0                | 0.00        |
| 5c  | 0                 | 0.00         | 0          | 0.00         | 0                | 0.00          | 0                   | 0.00         | 0                        | 0        | 0.00            | 0                | 0.00        |
| 6   | 0                 | 0.00         | 0          | 0.00         | 0                | 0.00          | 0                   | 0.00         | 0                        | 0        | 0.00            | 0                | 0.00        |
| Total| 205               | 37,896.28    | 45         | 8,754.62     | 88               | 31,356.66     | 347                  | 65,599.18    | 63                       | 68       | 9,899.42        | 39               | 9,207.30    | 3        | 551.27 | 189               | 43,624.15 | 1047               | 220,882.10 |

Answered 1047, Skipped 175
### Table 10: Patient outcome VS cost avoidance.

| Sex | Therapeutic End Point Reached | Patient's Condition Improved | Patient's Condition Worse | Laboratory Value Improved | Laboratory Value Worse | Patient's Mental Status Worse | Infection Improved | Infection Worse | Unknown | Total |
|-----|--------------------------------|------------------------------|----------------------------|---------------------------|------------------------|-------------------------------|-------------------|----------------|---------|-------|
| No  | No | Cost avoidance | No | Cost avoidance | No | Cost avoidance | No | Cost avoidance | No | Cost avoidance | No | Cost avoidance | No | Cost avoidance | No | Cost avoidance | No | Cost avoidance | No | Cost avoidance | No | Cost avoidance |
| 1a  | 6  | 157.02 | 0  | 0.00 | 0  | 0.00 | 1  | 26.17 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 1  | 26.17 | 8  | 209.36 |
| 1b  | 16 | 878.24 | 9  | 494.01 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 6  | 329.34 | 0  | 0.00 | 1  | 54.89 | 32 | 1,756.48 |
| 2a  | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 |
| 2b  | 3  | 91.05 | 15 | 455.25 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 6  | 182.10 | 0  | 0.00 | 101 | 3,065.35 | 125 | 3,793.75 |
| 2c  | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 |
| 2d  | 17 | 515.95 | 89 | 2,701.15 | 0  | 0.00 | 8  | 242.80 | 0  | 0.00 | 1  | 30.35 | 35 | 1,062.25 | 0  | 0.00 | 197 | 5,978.95 | 347 | 10,531.45 |
| 2e  | 6  | 182.10 | 6  | 182.10 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 1  | 30.35 | 0  | 0.00 | 32 | 971.20 | 45  | 1,365.75 |
| 2f  | 0  | 0.00 | 1  | 34.31 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 2  | 68.62 | 3  | 102.93 |
| 3a  | 62 | 16,148.52 | 251 | 65,375.46 | 3  | 781.38 | 27 | 7,032.42 | 3  | 781.38 | 0  | 0.00 | 21 | 5,469.66 | 4  | 1,041.84 | 62 | 16,148.52 | 433 | 112,779.18 |
| 3b  | 4  | 436.00 | 5  | 545.00 | 0  | 0.00 | 1  | 109.00 | 1  | 109.00 | 0  | 0.00 | 2  | 218.00 | 1  | 109.00 | 10 | 1,090.00 | 24  | 2,616.00 |
| 3c  | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 5  | 1,850.20 | 6  | 2,220.24 |
| 4a  | 0  | 0.00 | 1  | 370.04 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 5  | 1,850.20 | 6  | 2,220.24 |
| 4b  | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 |
| 4c  | 0  | 0.00 | 14 | 49,879.06 | 0  | 0.00 | 4  | 14,251.16 | 0  | 0.00 | 1  | 3,562.79 | 0  | 0.00 | 5  | 17,813.95 | 24  | 85,506.96 |
| 4d  | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 |
| 5a  | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 |
| 5b  | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 |
| 5c  | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 |
| 6   | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 | 0  | 0.00 |
| Total | 114 | 18,408.88 | 391 | 120,036.38 | 3  | 781.38 | 41 | 21,661.55 | 4  | 890.38 | 1  | 30.35 | 72 | 10,854.49 | 5  | 1,150.84 | 416 | 47,067.85 | 1047 | 220,882.10 |

Answered 1047, Skipped 175
Table 11: Pharmacoeconomic outcomes VS cost avoidance.

| Sex | Reduction in the Cost of Drug Therapy | Increase in the Cost of Drug Therapy | Reduction in the Cost of Drug Therapy Monitoring | Patient's Length of Stay Decreased | Patient's Length of Stay Increased | No Change in Costs | Total |
|-----|--------------------------------------|--------------------------------------|-----------------------------------------------|-----------------------------------|-------------------------------|-------------------|-------|
|     | No | % | Cost avoidance | No | % | Cost avoidance | No | % | Cost avoidance | No | % | Cost avoidance | No | % | Cost avoidance | No | % | Cost avoidance |
| 1a  | 7  | 87.50% | 183.19 | 1 | 12.50% | 26.17 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 8 | 0.00% | 209.36 |
| 1b  | 24 | 75.00% | 1,317.36 | 5 | 15.63% | 274.45 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 3 | 0.00% | 164.67 | 32 | 0.00% | 1,756.48 |
| 2a  | 0  | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 |
| 2b  | 121 | 96.80% | 3,672.35 | 2 | 1.60% | 60.70 | 2 | 1.60% | 60.70 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 |
| 2c  | 0  | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 |
| 2d  | 261 | 75.22% | 7,921.35 | 42 | 12.10% | 1,274.70 | 3 | 0.86% | 91.05 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 41 | 1.96% | 1,244.35 | 347 | 1.96% | 10,531.45 |
| 2e  | 36 | 80.00% | 1,092.60 | 1 | 2.22% | 30.35 | 2 | 4.44% | 60.70 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 6 | 0.00% | 182.10 | 45 | 0.00% | 1,365.75 |
| 2f  | 2  | 66.67% | 68.62 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 1 | 0.00% | 34.31 | 3 | 0.00% | 102.93 |
| 3a  | 362 | 83.60% | 94,286.52 | 31 | 7.16% | 8,074.26 | 10 | 2.31% | 2,604.60 | 3 | 0.69% | 781.38 | 0 | 0.00% | 0.00 | 27 | 5.10% | 7,032.42 | 433 | 5.10% | 112,779.18 |
| 3b  | 6  | 25.00% | 654.00 | 12 | 50.00% | 1,308.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 2 | 8.33% | 218.00 | 4 | 4.71% | 436.00 | 24 | 4.71% | 2,616.00 |
| 3c  | 0  | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 2 | 2.75% | 0.00 | 0 | 2.75% | 0.00 |
| 4a  | 3  | 50.00% | 1,110.12 | 3 | 50.00% | 1,110.12 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 54 | 54.90% | 2,220.24 |
| 4b  | 0  | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 1.57% | 0.00 | 0 | 1.57% | 0.00 |
| 4c  | 15 | 62.50% | 53,441.85 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 37.50% | 32,065.11 | 0 | 0.00% | 0.00 | 0 | 0.00% | 5.88% | 0.00 | 24 | 5.88% | 85,506.96 |
| 4d  | 0  | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 6.67% | 0.00 | 0 | 6.67% | 0.00 |
| 5a  | 0  | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 7.45% | 0.00 | 0 | 7.45% | 0.00 |
| 5b  | 0  | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 7.06% | 0.00 | 0 | 7.06% | 0.00 |
| 5c  | 0  | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 1.96% | 0.00 | 0 | 1.96% | 0.00 |
| 6   | 0  | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0 | 0.00% | 0.00 | 0.00% | 0.00 | 0 | 0.00% | 0.00 |
| Total | 837 | 79.94% | 163,747.96 | 97 | 9.26% | 12,158.75 | 17 | 1.62% | 2,817.05 | 12 | 1.15% | 32,846.49 | 2 | 0.19% | 218.00 | 82 | 100.00% | 9,093.85 | 1047 | 100.00% | 220,882.10 |

Answered questions 1047, Skipped questions 175
That is similar what reported by Aljbouri TM. Those medications highly interpreted by the pharmacist at critical care services with highly consequences problems and additional cost if they happened. The highest cost avoidance of type of interventions after other types was inappropriate dosing and TPN consultation. That is related to use of high-risk medications and expecting serious complications with the further incremental hospital of stay and high economic burden. The majority of cost avoidance less to patients improved conditions that's a clear economic outcome of a pharmacist working at critical care services. The results showed that is most of the cost avoidance due to drug therapy cost related mistake prevention and reduced complications with the sequenc- ing of reduction of hospitals stay. The type of cost calculation used was dosing adjustments related cost because of interventions related change dose or therapy duplication. The critical care pharmacist had a high economic impact of from very simple of pharmacy work-related interventions. We excepted higher cost if we include other services related setting guidelines, answering drug information inquiries and patients counseling services. The proving of a clinical pharmacist to critical care services at a private hospital is highly recommended in Riyadh city, Saudi Arabia.

**CONCLUSION**

The pharmacist plays a significant role at critical care services of the private hospital. The pharmacist condition improved, decrease drug therapy cost and patient length hospital stay. Expanding critical care pharmacist at a private hospital is highly recommended and appreciated in the Kingdom of Saudi Arabia.

**ACKNOWLEDGMENT**

None.

**CONFLICT OF INTEREST**

The authors declare that there are no conflicts of interest.

**ABBREVIATIONS**

MOH: Ministry of Health; HMG: Dr. Sulaiman Al-Habib Medical Group; GCC: Gulf Cooperation Council.

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