



A Review of Additional Cost in Personal Protective Equipment during COVID-19 Pandemic

COVID-19 Salgını Sırasında Kişisel Koruyucu Ekipmanların Ek Maliyetine İlişkin İnceleme

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Abstract

Objective: Personal protective equipment (PPE) use is crucial to protect the healthcare workers from COVID-19. This report aimed to compare the used amounts and additional costs of PPEs between the period of a complete one year of COVID-19 pandemic and the previous year before the pandemic.

Material and Methods: The study included two consecutive years; pre-pandemic period (March 11, 2019, to March 10, 2020) and pandemic period (March 11, 2020, to March 11, 2021). Data on of direct medical care cost items were calculated from the hospital perspective using a combination of the micro-costing technique (resource-based accounting method) and hospital list data.

Results: During the pandemic, the use of PPEs increased as 10-fold in surgical masks, 4.4-fold in gowns, 1.4-fold in non-sterile gowns, 12.5-fold in FFP3 respirators, 13-fold in FFP3 respirators with exhalation valves, 5.1-fold in safety goggles, 22.7-fold in face shields. The greatest cost increases were found in surgical masks (28.9 times), reusable face shields (12.9 times), and non-sterile gloves (7.6 times). During the pandemic, there was a 6.7 times increase in the total cost for PPEs with an additional cost of 200.972 USD.

Conclusion: Increased expenditure during the pandemic era was mostly due to increased usage of PPEs in different ratios.

Keywords: COVID-19, protective equipment, cost

Öz

Giriş: Sağlık çalışanlarının COVID-19'dan korunmak için kişisel koruyucu ekipman (KKE) kullanımı son derece önemlidir. Bu raporda, bir yıllık COVID-19 salgını dönemi ile pandemiden önceki bir yıllık dönemde kullanılan KKE'nin miktarlarını ve ek maliyetlerini karşılaştırmayı amaçladık.

Gereç ve Yöntemler: Çalışma, ardışık iki yılı kapsamaktadır: Pandemi öncesi dönem (11 Mart 2019-10 Mart 2020) ve pandemi dönemidir (11 Mart 2020-11 Mart 2021). Doğrudan tıbbi bakım maliyet kalemlerine ilişkin veriler, mikro maliyetleme tekniği (kaynağa dayalı muhasebe yöntemi) ve hastane liste verilerinin bir kombinasyonu kullanılarak hastane perspektifiyle hesaplandı.

Bulgular: Pandemi döneminde KKE kullanımı cerrahi maskelerde 10 kat, önlüklerde 4.4 kat, steril olmayan önlüklerde 1.4 kat, FFP3 solunum maskelerinde 12.5 kat, valfli FFP3 solunum maskelerinde 13 kat, koruyucu gözlüklerde 5.1 kat, yüz siperliklerinde 22.7 kat artış göstermiştir. En fazla artan maliyetler cerrahi maskelerde (28.9 kat), yeniden kullanılabilir yüz siperliklerinde (12.9 kat) ve steril olmayan eldivenlerde (7.6 kat) gözlemlenmiştir. Pandemi sırasında kişisel koruyucu ekipmanların toplam maliyetinde 6.7 kat artış yaşanmış ve ek maliyet 200.972 dolar saptanmıştır.

Sonuç: Pandemi döneminde artan harcamalar, çoğunlukla kişisel koruyucu ekipmanların farklı oranlarda kullanımındaki artıştan kaynaklanmıştır.

Anahtar Kelimeler: COVID-19, koruyucu ekipman, maliyet

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Introduction

The Coronavirus Disease 2019 (COVID-19) pandemic is a fact that has a major and devastating effect on healthcare systems globally (1). Health authorities such as World Health Organization (WHO) and Centers for Disease and Prevention (CDC) recommend and published many guidelines for usage of personal protective equipment (PPE) since the beginning of pandemic to reduce viral transmission for preventing the patients and the healthcare workers (HCWs) (2,3).

During the ongoing pandemic, increased requirements and also overuse of PPEs worldwide have led to difficulty in recruitment of many pieces of equipment as a result of changes in supply and demand balances. This non-predictable circumstance has also induced increases in costs which vary according to the period of the pandemic and the number of diagnosed or possible cases with COVID-19. Therefore, this report aimed to compare the used amounts and additional costs of PPE between the period of complete one year of COVID-19 pandemic and the previous year before the pandemic.

Materials and Methods

This retrospective study was conducted at the current hospital is a referral center for pediatric infectious diseases in the Aegean region of Türkiye with a 24-bed pediatric intensive care unit and a 65-bed neonatal intensive care unit. A total of 1.484 HCWs, including 287 doctors, 537 nurses, and 660 administrative staff work in the hospital. The emergency department serves about half of the population of the third biggest city in Türkiye.

To compare the influence of pandemic for amounts and additional costs of PPE, the study included two consecutive years; the pre-pandemic period (March 11, 2019, to March 10, 2020) and the COVID-19 pandemic period (March 11, 2020, to March 11, 2021). COVID-19 infection was reported on the 11th March 2020 as the first case in Türkiye. The indications of the PPE use were mainly based on the national guidelines (2-4).

Data of the direct medical care cost items were calculated with the hospital perspective using a combination of micro-costing technique (resource-based accounting method) and hospital list data. Information on specific components of PPE; including surgical masks, disposable gowns, FFP2 respirators, FFP3 respirators, FFP3 respirators with exhalation valves, safety goggles, disposable protective overall safety work wears, re-usable face shields, re-usable safety protective ratchet headgears with visor, hair restraints, overboots, and disposable protective overshoes covers. The investigators recorded the costs first in Turkish lira (TL) and converted to United States dollar (USD) using the average exchange rate between TL to USD currency between 11 March 2019 to 11

March 2021 (1USD= 7.4997 TL) (5). During the study periods, equal discounting of costs and health effects were applied and the costs were calculated in two different types, including adjusted cost and raw real-time cost. Adjusted costs included the calculation following: Cost for a specific PPE before pandemic/number of the PPE utilized before pandemic x PPE utilized during COVID-19 pandemic. Adjusted costs revealed the additional costs in consequence of the increase in PPE utilization. Raw real-time costs are the actual total money spent and might reflect costs in addition to the PPE numbers.

This study was approved by the Institutional Review Board.

Results

As of March 11, 2021, 607 confirmed COVID-19 pediatric cases, and additionally, 550 suspected COVID-19 cases were hospitalized at the study center. Among them, 577 patients (95.1%) were hospitalized at the pandemic ward, 19 patients (3.1%) at the neonatal intensive care unit, and 11 patients (1.8%) at the pediatric intensive care unit. In comparison to the pre-pandemic period, during the pandemic period, the usage of PPEs increased as 10-fold in surgical masks, 4.4-fold in gowns, 1.4-fold in non-sterile gowns, 12.5-fold in FFP3 respirators, 13-fold in FFP3 respirators with exhalation valves, 5.1-fold in safety goggles, 22.7-fold in face shields, 1.8-fold in hair restraints, and 1.2-fold in disposable protective overshoe covers, respectively. However, usage of sterile gloves decreased by one-half during the pandemic compared to pre-pandemic. Some of the PPEs were provided and came in the use for the first time during the pandemic including, disposable protective overall safety work wear, safety protective ratchet headgear with visor, and disposable overboot covers. Data on the consumption numbers and the diversity in consumption rates of PPEs during the study periods are shown in Table 1.

When compared to the total costs between the periods, total actual raw costs in a year were 35.082 USD before the pandemic and 236.054 USD during the pandemic (Table 1). As a consequence of the analyzed expenditures of each PPEs during the COVID-19 pandemic, the costs of the surgical masks were 71.047 USD, disposable gowns were 37.429 USD, non-sterile gloves were 49.797 USD, FFP2 respirators were 27.739 USD, and disposable protective overall safety work wears were 15.791 USD. The most significant increases in costs during the pandemic were found in surgical masks (28.9 times), re-usable face shields (12.9 times), and non-sterile gloves (7.6 times). Also, when the costs of the pre-pandemic period were adjusted according to the consumption amounts of PPEs during the pandemic, the estimated total raw cost was found to be 165.937 USD which was lower than the actual total cost of 236.054 USD paid during the pandemic period. During the pandemic, there was a 6.7 times increase in the total cost spent for PPEs with an additional cost of 200.972 USD. The direct cost

Table 1. Comparison of types of personal protective equipment, consumption numbers, consumption rates and costs including actual raw and adjusted total costs of PPEs during the study periods before and during COVID-19 pandemic

Types of Personal Protective Equipments	Consumption		Diversity in Consumption Rates	Actual Raw Costs		Adjusted Total Costs USD
	Before Pandemics (March 10, 2019-March 10, 2020), (n)	Since Pandemics (March 11, 2020-March 11, 2021), (n)		Before Pandemics (March 10, 2019-March 10, 2020), USD	Since Pandemics (March 11, 2020-March 11, 2021), USD	
Surgical masks	123.800	1.240.529	10.0	2.453	71.047	24.856
Gowns (disposable)	18.422	81.228	4.4	11.013	37.429	48.560
Gloves (non-sterile)	1.433.846	2.040.537	1.4	6473	49.797	9.212
Gloves (sterile)	26.143	12.374	0.5	11.764	3.554	5.568
FFP2 respirators	0	19.610	N/A	0	27.739	27.739
FFP3 respirators	558	6.976	12.5	554	5.580	6.932
FFP3 respirators with exhalation valves	500	6.532	13.0	375	6.038	4.899
Safety goggles	178	914	5.1	1.148	1.870	5.895
Disposable protective coverall safety work wear	0	2.909	N/A	0	15.791	15.791
Face shields (re-usable)	65	1.476	22.7	117	1.516	2.656
Safety protective ratchet headgear with visor (re-usable)	0	120	N/A	0	1.194	1.194
Hair restraints	52.800	92.900	1.8	751	3.310	1.322
Overboot covers (disposable), pair	0	31.100	N/A	0	10.779	10.779
Disposable protective overshoes covers, pair	62.100	75.900	1.2	432	402	528
Total costs, USD	N/A	N/A	N/A	35.082	236.054	165.937

N/A: Not applicable.

due to the increased amount of PPE used was 165.937 USD, and a 4.7 times increase at the adjusted total cost and additional cost due to the increased usage of PPE was 130.855 USD.

Discussion

This report shows that some key items of the PPEs significantly increased in use up to almost 12.5 times during the first year of the COVID-19 pandemic compared to the previous year before the pandemic. Some items such as disposable protective coverall safety workwear, safety protective ratchet headgears with visors, and disposable overboot covers have been used for the first time, resulting in a significant increase in the money spent for PPE during the COVID-19 pandemic. Also, during the pandemic, the costs of PPEs are associated with a higher actual total cost of PPEs compared with the estimated total raw costs for the pre-pandemic period (36.054 USD vs. 165.937 USD), reflecting the increased price of PPE's due to increased demand through the pandemic era.

Personal protective equipment stands out as the most important protective barrier to prevent the spreading of COVID-19 to the HCWs, even if vaccinated with COVID-19 vaccines (6). In the initial phase of the pandemic, as a result of the domestic and global demand for PPEs has surged, an enormous problem of PPE shortages was experienced worldwide to a different degree (7,8). An international survey showed a dramatic fact that half of the responders had been suffered from PPE shortages (9). In the study center, since the first official announcement of the COVID-19 case in Türkiye, the shortcomings of the PPEs were accomplished immediately according to the guidelines of recommendations of the local hospital infection control committee (4).

Regarding our hospital, a significant increase in the usage of FFP3 respirators (with and without exhalation valves) in addition to the usage of FFP2 respirators. There was no consensus on the recommendations for the usage of surgical masks versus respirators. While WHO and Public Health England rec-

ommend the restricted usage of respirator masks to the aerosol-producing procedures, CDC and European Centre for Disease Prevention and Control recommend the universal use of respirators for all cases when available (10-13). Although the facility-based infection control committee tried to restrict the respirator usage to the aerosol-producing procedures, the respirators were used widely beyond indications. The main factor for this usage in our hospital is as following: Being a children's hospital since the rate of asymptomatic COVID-19 infections were more common at the children, besides being a pandemic hospital, outpatient and inpatient clinics were active throughout the COVID-19 pandemic. To overcome the over-uses of respirators, the principal key is longer and/or re-use of respirators according to the CDC guidelines (14,15). Although it is not recommended, we had to use the respirators with exhalation valves within a coverage with surgical masks due to the storage of FFP2 and FFP3 masks according to our institutional policy (16). The face shields and safety goggles were indicated for special contagious diseases before the pandemic, thus were utilized in small amounts before the COVID-19 pandemic, while these PPE's became a standard element of PPE's for the care of confirmed and suspected COVID-19 patients during the COVID-19 pandemic.

The major component of the expenses spent for PPEs was the surgical masks. Within a short time after the official announcement of the first case in Türkiye, on 3 April 2020, mandatory facial mask usage in public areas was obligated. For this reason, the utilization density of the surgical masks increased because every employee even not operational or not directly involved in patient care used surgical masks. The second most expensive was disposable gowns with an increase of 4.4 times of usage and nearly four times of increased cost, despite disposable gowns are a major part of contact isolation, due to the burden of COVID-19 patients at hour hospital, gowns became an indispensable part of our ordinary life. Compared to the pre-pandemic period, it was observed that there was only a decrease in the use of sterile gloves during the pandemic period. The decrease in sterile gloves, the decline in elective surgeries during the COVID-19 period were attributed to the decline in the number of procedures.

Limited studies are focusing on the additional cost of PPEs during the COVID-19 pandemic. In the current study, approximately an additional 200.000 USD was spent for the PPE's during the COVID-19 pandemic. One study, from England, focusing on the additional cost of PPE used had an extra cost of an extra 32.292 pound, while this study mainly focused on an oral and maxillofacial unit (17). Besides, according to the Society for Healthcare Organization Procurement Professionals, the hospital responsible for care for COVID-19 patients had experienced nearly a 1.064% increase in costs (18). However, this study showed nearly seven-times more cost during the pan-

dem, mostly associated with an increase in the PPE usage and although it has less effect, due to the increase in prices due to the increase of demand at the supply and demand balancing for PPEs at the both of the international and national markets.

Several considerations should be noted when interpreting the results. Firstly, this was a retrospective study, which has inherent limitations when compared to randomized clinical trials. Secondly, personal compliances of HCWs for proper use of PPEs were not observed, and might not exactly show the clinical reflections at the respirators, since people tended to use them more than indicated. However, up to our knowledge, this is one of the studies directly showing the cost of protecting HCWs during the COVID-19 pandemic.

Conclusion

In conclusion, the additional PPE expenditure for the first year of the COVID-19 pandemic was 200.972 USD at our hospital. The increased expenditure during the COVID-19 pandemic era was mostly due to increased usage of PPEs, also, to increase in the prices depending on the increase in demand in the balance of supply and demand. However, it should be kept in mind that it is a price that must be paid to protect healthcare workers, and regarding the efforts of healthcare professionals, it is not open to discussion.

Ethics Committee Approval: This study has been stated to not require ethics committee approval since it is a retrospective study.

Peer-review: Externally peer-reviewed.

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