

**STUDYING THE CONSUMPTION PATTERN OF ENERGY CARRIERS BEFORE AND AFTER
SUBSIDIARY REFORM PLAN IN SELECTED HOSPITALS OF KURDISTAN
UNIVERSITY OF MEDICAL SCIENCES¹**

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ABSTRACT

Subsidiary reform plan enforcement and growing prices of energy carriers will lead to difference in hospitals costs. This study aimed to determine the energy consumption pattern before and after subsidiary reform plan enforcement from 2007 to 2013 in selected hospitals of Kurdistan University of Medical Sciences. This study is applied and sectional- analytic research and is conducted in 2014. Study population consists of Kurdistan University of Medical Sciences hospitals including Tohid, Besat and Qods hospitals that were studied by census. Document review in terms of costs and consumption in a six-year period was the basis for data collection and data was entered into Excel software and independent t-test and Minitab 17 software were used for statistical analysis. Independent t-test showed that there is no significant difference in average monthly amount of gas consumption in three years before and after subsidiary reform plan of studied hospitals except Qods hospital (pvalue=0.414), (pvalue=0.516) and (pvalue=0.061). The average monthly payment of three hospitals was more compared to three years before and after subsidiary reform plan (pvalue = 0.000).we need a comprehensive and purposeful planning, training and cultural building of employees and officials on energy consumption and provide measures to hospitals according to subsidiary reform plan in order to meet the cost of energy carriers in health care centers and obtain energy consumption pattern through adapting predetermined standards.

KEYWORDS: Energy carriers, Hospitals, Kurdistan, Subsidiary reform plan.

INTRODUCTION

One of the most important factors of production in economy system is energy and service activities are done through its consumption (Asgharpur, 2008). According to public awareness of energy costs, the need for conserving resources is increased and increased energy resource prices and their shortage have led to supervision over their consumption (Sadaghiani, 2010). Population growth, the emergence of new diseases and cost of treatment services, have developed medical technology that is the most important service sectors, and have attracted managers of health care institutions have led to devote of these costs to hospitals in most countries (Hassanzadeh, 2009) and (Sharifi, 2009); according to World Health Organization, approximately three-quarters of total budget of health sector in developing countries has growth (Uri, 1997). Since the changes in prices, wages and taxes have direct effects on health centers as the first referral level in health system, rapid growth in using technology in health sector has increased energy demand and consequently the cost of energy as an expenditure resources of hospital (Sadaghiani, 1998 and Aghamohammadi, 2010) and any problem in development and utilization of energy resources disrupts directly service patients and even endanger their lives (Haj Saqati, 1998).

Energy costs constitute about 5 to 7 percent of hospital budget (Sadaghiani, 2010). Government has allocated subsidies to social target groups (Medical Services Insurance Organization, 2009) through subsidiary reform plan and prevents the waste of energy achieving social justice (Department of Commerce, Bureau of Economic Research, 2009).

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Government must revise energy carriers prices based on subsidiary reform plan. Subsidiary reform plan includes 16 articles and 16 amendments that were approved by Guardian Council in open session of parliament on Tuesday 01/15/2009 (Parliament, 2009). The plan on energy carriers was performed on 29 December 2010. Being aware of the fact that so much time has not passed since the implementation of subsidiary reform plan in country, this plan will certainly effect on energy consumption that in turn will have positive or negative effects (Debo, 2003).

A study entitled “comparing the energy consumption before and after the implementation of subsidiary reform plan in hospitals of Qazvin University of Medical Sciences in 2012 using t-student test showed that there was no significant difference in average monthly consumption of water, power and gas in a year before and after the implementation of subsidiary reform plan in studied hospitals (Pvalue=0.457), (Pvalue=0.64), (Pvalue=0.68). But the average monthly payment of all three in one year before and after the implementation of subsidiary reform plan was significantly higher than before (Pvalue<0.001) (Asefzadeh et al., 2011).

Another research entitled “effects of subsidiary reform plan of energy carriers on Hotelling cost at Tehran Shahid Hasheminejad Subspecialty Center in 2013 showed that Hoteling cost in 2010 was 49 424 million riyals and with a difference of 4938 (11.1%) was more than 2009 (44,485) and in winter of 2009 (18829) with a difference of 1826 (10%) was more than winter 2010 (17,003). Energy cost in 2010 (1372) with a difference of 622 (83%) was more than 2009 (749) and in winter of 2010 (577) with a difference of 348 (167%) was more than winter 2009 (209) and finally they concluded that Hotelling cost has declined in winter of 2010 (after implementation of subsidiary reform plan). This decrease is due to a change in behavior of measurement other than energy carriers including service compensation, maintenance and detergents (Nasiri-Pour et al., 2013).

A study entitled “Studying the effect of subsidiary reform plan on health care costs of Esfahan University of Medical Sciences in 2009-2011 showed that due to the increase in tariff energy rates and rising costs at university hospitals and 6 times increase of costs, energy costs share from total health care expenditures were 0.37% to 0.5% in 2009, that is, energy costs, however, changing energy tariffs, current share has reached 9.1 to 2 of total costs, this increase is significant and effective (Roshaniayn *et al.*, 2013). Considering the fact that energy costs constitute a significant portion of non- personnel costs in hospitals, with the current trend of primary energy consumption in country, these costs will increase and according to the fact that the cost of room and food makes up 10% of hospital costs (Shepard, 2007) and cost of health care goods and services (hospital), particularly the hospital Hotelling cost increases, self-management plan and hospitals Board of Trustees will be effected, too (Abumasudi, 2005).

Factors such as implementation of subsidiary reform plan and its effect on different parts of country including in health sector, its costs and tariffs and lack of research in this field are important aspects of this study. It is clear that subsidiary reform plan effects on many variables, but in this study, only effect of changes in energy prices resulting from implementation of subsidiary reform plan on hospitals related to Kurdistan University of Medical Sciences will be examined. The overall aim of this study was to determine the energy consumption pattern of energy carriers before and after implementation of subsidiary reform plan from 2007 to 2013 in selected hospitals of Kurdistan University of Medical Sciences.

MATERIALS AND METHODS

This study is applied and sectional- analytic research and was conducted in 2014. Study population consists of Kurdistan University of Medical Sciences hospitals in Sanandaj including Tohid, Besat and Qods hospitals. Sampling was not used and all hospitals were studied by census. Document review in terms of costs and consumption in a six-year period of 2007-2013 was the basis for data collection and data was collected from accounting units in order to study consumption and costs of water, power and gas bills. Accounting units entered data into Excel software and end price was identified. The significant difference between data was analyzed using independent t-test and Minitab 17 software.

RESULTS

In calculating the amount of consumed water, Tohid hospital had water saving compared to three years before implementation of subsidiary reform plan, the savings rate was 29.3 per cent and Besat and Qods hospitals had

increased consumption rate of 1.02 and 66.8 percent (Figure 1). Qods hospital had only saving of 11.41 in power consumption; other hospitals had consumption growth so that Besat and Towhid hospitals had consumption growth of 17.5 and 4.12 percent (Figure 2). Also, Besat hospital in three years after implementation of subsidiary reform plan had saving in gas consumption to 9.5 but Qods and Towhid hospitals had consumption growth of 27.05 and 4.9 percent (Figure 3).

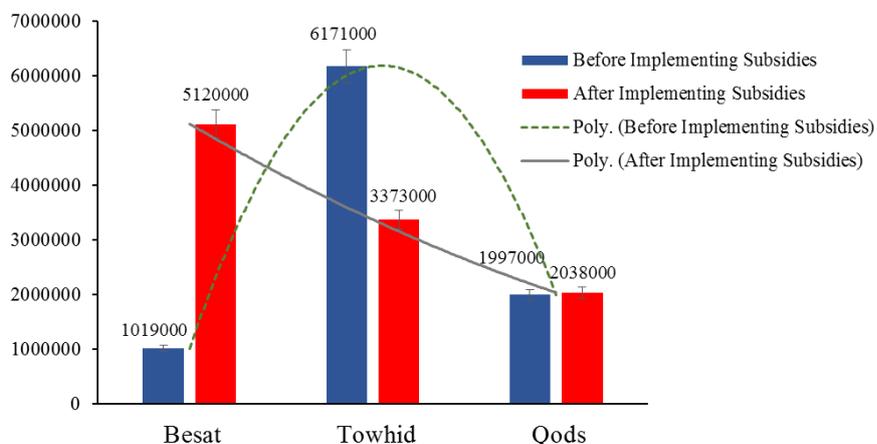


Figure 1. Compares the average water consumption (liters) hospitals, three years before and after the implementation of subsidies

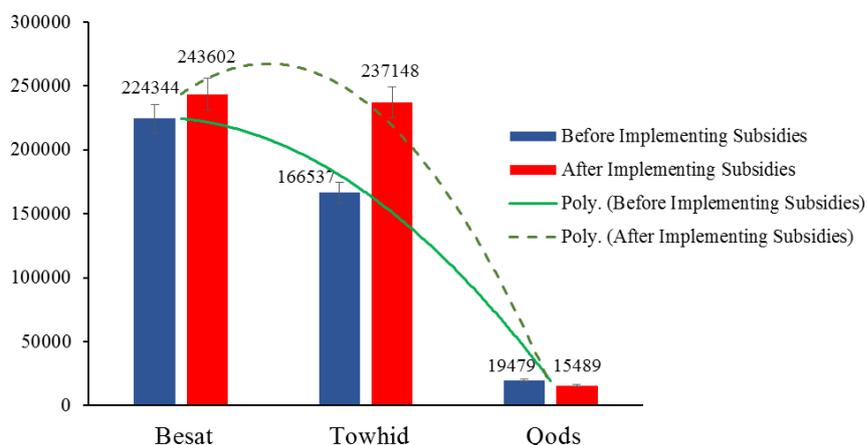


Figure 2. Compares the average power consumption (kwh) hospitals, three years before and after the implementation of subsidies

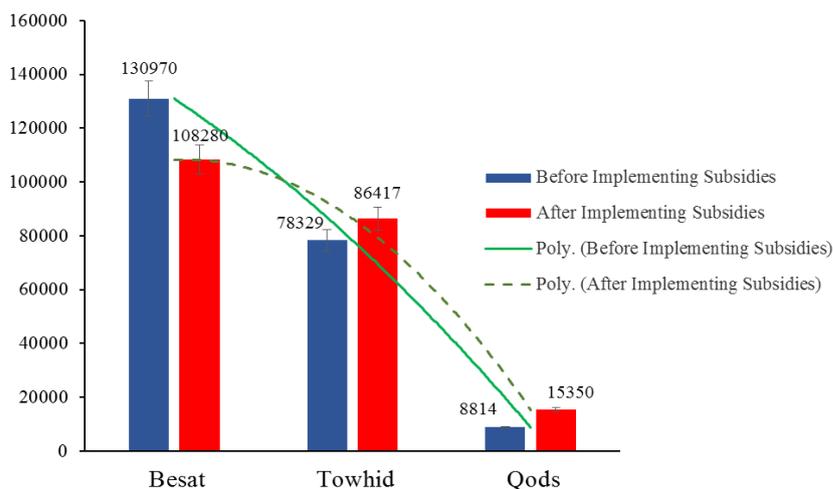


Figure 3. compares the average gas consumption (m³) hospitals, three years before and after the implementation of subsidies

Independent t-test showed that average monthly water consumption in three years before and after subsidiary reform plan of Besat Hospital with increased consumption showed significant difference (pvalue=0.00) and Tohid Hospital with reduced consumption showed a significant difference (pvalue=0.00), but Qods Hospital did not show significant difference (pvalue=0.159). average monthly power consumption in three years before and after subsidiary reform plan of Besat Hospital with increased consumption showed significant difference (pvalue=0.08) and Tohid Hospital with increased consumption showed a significant difference (pvalue=0.00), and Qods Hospital with reduced consumption showed significant difference (pvalue=0.030). and finally, average monthly gas consumption in three years before and after subsidiary reform plan of Besat Hospital did not show significant difference (pvalue=0.414) and Tohid Hospital did not show significant difference (pvalue=0.516), also, Qods Hospital did not show significant difference (pvalue=0.061).

Table 1. Comparison between the mean amount and cost of water, power and gas consumption monthly in the years before and after implementing subsidies in studied hospitals

Variable	Before implementing subsidies		After implementing subsidies		F	Pvalue
	Standard deviation	Mean	Standard deviation	Mean		
Monthly water payment	3812305	427080	36175613	40349372	162.071	0.000
Monthly-water consumption	3063	2750000	3510	2970000	0.155	0.695
Monthly power payment	1642723	2341654	4889807	3232700	65.146	0.000
Monthly power consumption	136787	106968	165413	135973	7.821	0.006
Monthly gas payment	14314778	1900449	78937268	12576572	62.07	0.000
Monthly-gas consumption	80509	11762	67728	8463	0.730	0.395

DISCUSSION

Since energy cost of hospital constitutes about 5 to 7 percent of budget (Abumasudi, 2005), in other words, according to Energy Management report in Health care sector, nearly 10 percent of hospital costs are spent on purchasing energy carriers, therefore, developing strategies and policies are done considering future prediction criteria. Therefore, developing appropriate plans and allocating optimal management of energy is very important (Ministry of Petroleum,

2010). The aim of this study was to determine the energy consumption pattern before and after subsidiary reform plan in energy carriers in selected hospitals of Kurdistan University of Medical Sciences 2007 to 2013 (in a six years period). The results showed that despite a dramatic increase in energy consumption costs of studied hospitals, energy consumption was not significantly different. The study findings reflected the fact that average cost of water, power and gas costs in studied hospital after implementation of subsidiary reform plan was increased 9, 3 and 5 times, respectively and this figure is very impressive and important.

In the case of comparing energy consumption before and after implementation of subsidiary reform plan of Qazvin University of Medical Sciences hospital, Asefzadeh states that increased price of energy carriers does not lead to changes in energy consumption of hospitals (Asefzadeh et al., 2011). Hassanzadeh states that energy consumption has been increased due to lower domestic prices, domestic energy consumption of Iran is very high compared to international standards and finally, energy demand growth is much greater than income growth rate per capita in most low-income and high income countries (Hassanzadeh, 2009). The results of present study show a high level of energy consumption in hospitals.

In the case of increased energy consumption costs after price adjustment, Fetini and Bacon using input-output model, examined effects of energy prices within Iranian borders, energy carrier price increase on prices of other economic sectors. The results indicate that adjustment of prices to border price level will result in 13% increase of general prices (Fetini and Bacon, 1999). The study results reflect the fact that the general level of energy prices has increased 5.7 times. Uri and Boid study results on examining the economic effect of increased energy carrier prices in Mexico presents that increased prices leads to reduced energy consumption by households and producers, reduced output in manufacturing sectors that are consumer of energy carriers, reduced destructive effects of environment and finally increased receipt by government (Uri, 1997). The results of current study offers reverse results with Uri and Boid and agreed results with Asefzadeh results. So that, increasing energy carrier prices, no changes were found in energy consumption of hospitals. Firstly, we determine a set of consumption standards in various sectors according to the latest level of technical efficiency and other factors that influence the energy consumption to optimize power consumption and then present them to producers and consumers in various sectors in the form of solutions that can be implemented. In this way we can reduce energy consumption pattern somewhat closer to determined standards (Abumasudi, 2005).

What can be observed in the present study is the lack of impact of subsidiary reform plan on consumption of hospitals. This is while the main aim of this plan is to reduce energy consumption. The remarkable point is that price increases without providing the needed infrastructure has led to this issue. This is while hospitals continue to their services with previous models and programs to reduce energy consumption in hospitals has not been designed and developed, therefore, reducing energy consumption did not happen during one year after subsidiary reform plan. On the other hand, Subsidies would generally be regarded as an economic tool that before study on how to do it like other financial instruments, its positive and negative effects cannot be judged (Rahimi, 1996). Subsidies in general and energy subsidies in particular have has, direct and indirect consequences and effects (Varmazyar, 2010). Energy resources can be a source of health system. Since the hospital administrators are faced with limited energy resources, efficient use of these resources leads to effective and efficient services to patients. On the other hand, energy cost has devoted significant part of non-personnel costs to itself and effects directly on unit cost of each services unit provided to hospitals, moreover, it effects on self- management plan of hospitals (Haj aborted, 1998).

In our country, there are nearly 120 thousand beds in thousands of hospitals (public and private), and about 18 million health care centers and 2600 health centers and thousands of paraclinics such as pharmacies, dentists, radiology and physiotherapy and given the existing medical equipment, energy carrier consumption for lighting and heating is very high (Roshaniyan, 2011). The importance of powering hospitals and proper use of energy resources is to the extent that many hospitals decide to establish supply and energy committee and thus encourage all hospital staff on correct use of energy, especially their safety and inhibition (Sadaghiani, 2010). From economic and environmental point of view, reducing energy consumption and its costs are main components of planning, construction and use of buildings. In recent years, energy consumption and plan to reduce energy are focused (Stoy & Pollalis, 2014). Iranian buildings consume energy six times European buildings and 40% of non- renewable energy of country is consumed in buildings sector.

Although, hospitals don't provide independent and distinguished statistics in the context of energy consumption, because of the importance of using a variety of hospital equipment, it is clear that all types of residential, office and business buildings consume energy. The main reasons for growth of power consumption in country's hospitals include increased number of hospital beds, import of new energy consumer equipment and accessories especially in paraclinic sectors, higher levels of social welfare and changes in hospital Hotelling requirements, climate change and increasing need for electric heating and cooling systems, low energy prices and tariffs before subsidies, low efficiency and effectiveness of different types of electrical appliances in country, failure to observe proper patterns of energy use by staff and patients and finally high mortality of energy consumption in hospital facilities.

CONCLUSION

Lack of standards for energy consumption in buildings, lack of authority for optimization of energy consumption in buildings (energy management), inaccurate and incomplete use of new technologies in construction sector and non-compliance with national regulations of country, low technical knowledge of staff on hospital buildings, insufficient knowledge of beneficiaries in optimizing the energy consumption of buildings and high intensity of energy consumption are among the main reasons for lack of energy efficiency in hospital buildings.

In the case of energy efficiency of hospital buildings, firstly, we must do energy audits and pre-feasibility studies that is a standard method in world; in this context we can use tens of energy services companies of country. In the case of new hospital buildings, applying rules and procedures of National Building Regulations especially topic 19 by engineering supervisors play role in optimizing energy consumption. We need a comprehensive and targeted planning, training and cultural building of employees and officials in order to meet energy carriers' costs in health centers through implementation of subsidiary reform plan and achieve energy consumption model through implementing standards to hospitals.

SUGGESTIONS

Department of Management and Resource Development supported by Kurdistan University of Medical Sciences that has the mission of providing advice and suggestions in order to modify existing processes to increase efficiency of income and reduce costs of university and related centers, using the HSR project, creates a healthy competition between health centers in order to institutionalize a culture of saving in centers and be able to solve existing problems, providing models and optimizing energy consumption in hospitals that have been mentioned below:

A: The optimization of power consumption: Significant savings in energy consumption and overall costs can be achieved through effective use of power in buildings including:

- 1) Replacement of lamps with higher efficiency and lower consumption: according to official statistics of state, 30% of the electrical energy used in buildings is usually for lighting aims; this amount for medical centers does not differ for other buildings; therefore hospital consumers are offered to replace LED lamps with 3 to 5 watts consumption with halogen lamps which consume 50 watts power in order to reduce electricity costs. Replacing LED lamps instead of halogen lamps is one of the quick solutions to save energy provided they consider technical considerations and provide LED lamps from authoritative resources.
- 2) Installing more transparent bubbles and regular cleaning of lamps and bulbs
- 3) Defining energy label for hospital building components: building energy labeling is appropriate and effective means of explaining standards for energy consumption in buildings and evaluation of optimizing energy consumption design during designing and utilizing the building. The energy label has long been used in Electronic applications and effects appropriately on consumers and manufacturers of this equipment.
- 4) When light is enough or there is no need to light because of empty rooms or hallways, hospital staff are encouraged to turn off lights.
- 5) Limiting the use of glass in building facade: Buildings with glass facades have a lot of problems and cause the greatest loss of energy, unfortunately, most of these buildings are public buildings, for example banks and government ministries as well as hospitals. Authorities recently try to correct the building's façade and do necessary measures, especially for energy saving.
- 6) Intelligent lighting system: Energy efficiency organization studies and implement solutions to optimize energy consumption of lighting system and organize lighting of 10 public office building in order to develop a model for reducing energy consumption and intelligent lighting systems of office and public buildings.

- 7) Intelligent air conditioning system: Studies show that share of air conditioning or heating and cooling varies in different climate regions for example, about 35 percent in temperate regions of the central provinces of country, about 60% in hot and humid southern provinces and about 30% in cold areas of western provinces including Kurdistan Province.

B. Heating and cooling systems: Energy consumption can be reduced installing a timer with respect to use of heating and cooling systems. On the other hand, using PVC double glazed windows will be useful to prevent energy waste. Installation of thermal insulation for pipes of powerhouse and using intelligent architecture structures for hospital spaces must be considered by medical authorities.

(C) Optimization of water use:

- 1) We can get help from Agriculture Organization for drip irrigation of agricultural landscape in designing and implementation and use possible plant species that need less water and cover a wider area and gradually remove grass from green space and use colored pebbles and ornamental granules instead of grass, this plan will save water 50 to 80 percent.
- 2) Irrigation of green areas of hospitals in the morning from 7 to 9 am.
- 3) Using well water to wash floors of buildings and even primary wash of utensils.
- 4) We can get help from Agriculture Organization for drip irrigation of agricultural landscape in designing and implementation and use possible plant species that need less water and cover a wider area and gradually remove grass from green space and use colored pebbles and ornamental granules instead of grass, this plan will save water 50 to 80 percent.
- 5) Providing scrubbing machines for great environment floor; due to its filter, water can be recycled and re-refined and environment disinfected as a result considerable water and manpower will be saved.
- 6) Using circulation machines for recycling waters used in fountains and hospital fountains or using it in hot water tubing in order to prevent waste of cold water.
- 7) Using pressure or pedal taps for all water dispensers especially in hospitals and public places.
- 8) Using sensor taps instead of rotating taps.
- 9) Replacing previous flash tanks having 18 liter tank with new dual-mode flash tanks that discharge 6 liters water with pushing one button, and 9 liters of water with pushing second button based on person needs and water consumption will be reduced by 50% with this method.
- 10) Using scrub electronic taps in operation rooms under review shows that washing hands of surgical team with lever taps takes 7 minutes and 31 seconds while using scrub special sensor taps will reduce the time to 28 seconds.
- 11) Using washing sets in operation rooms and laboratories for cleaning glass test tubes can reduce considerably water consumption; otherwise we can use plastic r polymer testing pipes.
- 12) Replacing laundry machines that are old and some are leaking with new industrial machines that have A++ energy label, using industrial dishwashers to wash dishes, this not only reduce water consumption but also effectively reduce time and manpower. Using these machines can reduce water consumption by 70%.
- 13) Since dialysis patients consume at least 150 liters of water for every dialysis, we can mix its wastewater with an equal volume of fresh water for cleaning floors in order to re-use RO water of dialysis machines, but it must not be used for irrigation of green areas.
- 14) Establishment of canopy for coolers can reduce water consumption, because much of cooler water is evaporated.
- 15) Set up water table of cooler pond and cooling towers in early morning or late evening and adjust regularly its flutter will prevent overflow of treatment centers water.
- 16) Periodic maintenance and repair of hospital cooling towers facilities by officials of Medical University in order to clean the growth mud and algae and sediment in ponds, however, the pond water table must be set at conditions that ponds don't overflow in on- off of water towers.
- 17) Isolating and covering outdoor hot and cold water pipes in order to prevent the energy waste.
- 18) Using underground channels for availability and visibility of leaks in pipes and fittings.
- 19) Using educational aids such as banners, stickers, brochures and leaflets and electronic signs in hospitals especially in traffic places in order to save urban water consumption.

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