




## International Sanctions and the Procurement of Medical Equipment in Iran: A Qualitative Study

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### Abstract

**Background:** Despite regulations to facilitate the purchase of medical equipment, the process is now faced with severe challenges due to the sanctions. This study focuses on the effects of the international sanctions on the process of procuring capital medical equipment in the Iranian health system.

**Methods:** A qualitative study using a content analysis approach was designed to investigate the effects of the international sanctions on capital medical equipment from January 2018 to June 2019. The data were gathered through 32 face-to-face, semi-structured interviews according to an interview guide. All the interviews were transcribed verbatim and analyzed accordingly. Thematic analysis with an inductive approach was employed for analyzing the data.

**Results:** After a comprehensive analysis of open codes, two themes and 9 sub-themes were formulated. Based on our findings, the challenges facing the Iranian health sector during international sanctions included: “procurement of capital medical equipment” (with 6 sub-themes: Capital medical equipment suppliers, Monetary and interbank transactions, Suppliers and importers of the capital medical equipment, The process of procurement of capital medical equipment, Healthcare providers and Service receivers) and “repairing and after-sales services of capital medical equipment,” (with 3 sub-themes: Software and spare parts dependent repair, Specialized human resources dependent repairing and after-sales services).

**Conclusion:** Even though the sanction has made Iranian scientists and technicians capable of re-engineering and producing some of the medical equipment and accessories, the study confirms the adverse effects of sanctions on the quality and quantity of medical equipment procurement, hence, delivering adequate and on-time medical services. In many cases, for money transfer issues, international companies were not sure they could have their money back if they sold the facilities to Iran. Fear of losing the US market was the other main consideration for the international companies.

**Keywords:** Sanction, Medical Equipment, Health System, Iran

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### Introduction

Providing health services with desirable quality depends on the optimal management of health system resources.

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#### ↑What is “already known” in this topic:

International sanctions have harsh effects on the health of people in countries imposed by sanctions.

#### →What this article adds:

International sanctions caused some serious barriers and challenges in importing capital medical equipment in Iran. Hence, diagnosis and treatment of many diseases confront difficulties. Some of these challenges are in the area of capital medical equipment suppliers, Monetary and interbank transactions, Suppliers and importers, The process of procurement of medical equipment, Healthcare providers and Service receivers, Software and spare parts dependent repair, Specialized human resources dependent repairing and after-sales services.

Among the resources used in the health system, it can be said that medical equipment like human resources plays an important role in the performance of health care service providers, including hospitals. In fact, in order to provide safe and quality services and increase patient satisfaction, the health system should pay special attention to the management of medical equipment (1).

The process of procurement of medical equipment has a significant impact on the function and performance of healthcare organizations, including hospitals (2). This process has exceptional importance when it comes to the capital medical equipment due to its role in the diagnosis and treatment of diseases. Many of this equipment is manufactured in the developed countries and developing countries like Iran must buy this equipment and from other countries (3). Improper purchase process and the mismatch between the technology and the demand are among the challenges to the health system (4, 5) and any shortcoming in this phase can lead to failure in the performance of a hospital (6).

The procurement of medical equipment in Iran is severely affected by international sanctions (7). Although the sanctions put political and economic pressure on the states, studies show that they have harsh effects on ordinary people, especially on the poor, the sick, and those with disabilities (8, 9). Studies suggest that economic sanctions on Iran have affected all the economic sectors. Scarcity of medicine and raw chemical materials for pharmaceutical companies, shortage of hospital medical equipment, and dramatic decline in the procurement of medicine have been among the considerable challenges in different rounds of sanction (10, 11).

Despite regulations to facilitate the purchase of medicine and medical equipment, which were mostly purchased from developed countries, the process is now faced with a severe challenge due to the sanctions (12). This study focuses on the effects of the international sanctions on the process of procuring capital medical equipment in the Iranian healthcare system.

## Methods

A qualitative study using a content analysis approach was designed to investigate the effects of the international sanctions on procurement, repair and after-sales services of capital medical equipment in the Iranian health system.

The participants included key informants in procurement and management of capital medical equipment from the public and private sector at the Iran Ministry of Health and Medical Education (MoHME, FDA), medical equipment managers, experts in medical universities and hospitals, and hospital managers. To identify and select these key informants, purposeful sampling was used with a maximum variation approach.

Other than the Ministry executives and managers, eligible participants were experts with more than 3 years of executive experience in the field of medical equipment and faculty members who had done researches in this area.

The required data were collected through face-to-face, semi-structured interviews. We developed an interview

guide according to the study objectives and after a deep interview with two experts from Iran MoHME. Further, to test the validity of the interview guide, the questions were reviewed by the research team with the collaboration of three experts from the MoHME and necessary changes were made accordingly.

Interviews were carried out in the interviewee's office. The interviews continued until saturation point, in which no additional data collection was necessary. It is attained with the analysis and comparison of interview contents until no new or relevant data seems to be emerging concerning a theme. Lastly, 32 interviews were conducted. Each interview took 15–80 minutes, with an average of 42 minutes. All interviews were recorded (with participants' informed consent) and then transcribed verbatim.

Thematic analysis with an inductive approach was employed according to a step-by-step guide proposed by Braun and Clarke (13). Accordingly, (1) data coder immersed himself in the data by listening to recorded interviews and reading and re-reading transcribed data, (2) the initial list of ideas behind the data was generated, and the initial codes from the data were produced, (3) after that, the data were coded and then analyzed thoroughly, (4) the themes and sub-themes were reviewed and refined during two 2-hour sessions with the research team, (5) reviewed final themes were noted considering the cross-links between themes and sub-themes, and (6) the report was produced. For assessing the quality, we ensured four trustworthiness criteria presented by Lincoln and Guba (14). Credibility was ensured with a prolonged engagement and respondent validation (the process whereby the researchers provided some transcribed interviews to the participants and asked them to ensure that there is a good correspondence between their findings and the perspectives of participants). Furthermore, to improve credibility, opposite issues in findings were discussed among the research team.

The transferability of qualitative findings was enhanced through purposive sampling and informative descriptions. Dependability was adopted by using an auditing approach in which the researcher team, accompanied by an external auditor, engaged in complementary comments in the coding process and analyzing of interview text as well as cross-checking the collected data. For conformability, we checked the researchers' objectivity while analyzing the data.

We maintained reflexivity by using field note-taking to enrich the data. Moreover, we have tried to shrink the impact of our experiences on various stages of the study process.

## Results

A total of 32 persons from various sectors participated in the study (Table 1). Through the interviews, participants pointed out the challenges the Iranian health system are faced with in the field of medical equipment during the international sanctions period.

The following is the explanation of themes, sub-themes, and codes, followed by some quotes from the interviewees for further clarity.

Table 1. Composition of participants

Participant	No.
Policymakers from MoHME, FDA	9
Members of Currency Board of Trustees	3
Head of medical equipment department at medical universities	2
Public and private hospital manager	5
Head of medical equipment department at selected hospitals	7
Members of the board of directors in private medical equipment companies	6

After a comprehensive analysis of open codes, two themes and 9 sub-themes were formulated. Based on our findings, the challenges facing the Iranian health sector during international sanctions included: “procurement of capital medical equipment”(with 6 sub-themes: Capital medical equipment suppliers, Monetary and interbank transactions, Suppliers and importers of the capital medical equipment, The process of procurement of capital medical equipment, Healthcare providers and Service receivers) and “repairing and after-sales services of capital medical equipment,” (with 3 sub-themes: Software and spare parts dependent repair, Specialized human resources dependent repairing and after-sales services) (Table 2).

### Theme 1. The impact of sanctions on procurement of capital medical equipment

This theme has been divided into 6 subthemes of foreign companies manufacturing and offering capital medical equipment, money transfer, and interbank transactions, import companies, sales representatives, the process of procurement of capital medical equipment, Healthcare providers using capital medical equipment, and service receivers. We will deal with each of them presently.

#### 1.1) Foreign companies manufacturing and offering capital medical equipment

The sanctions have led to international brands' reluctance to cooperate with Iran, distrust of companies manufacturing and providing capital medical equipment due to limitations imposed on economic and monetary transactions, international brands' termination of their contracts with Iran for fear of penalties considered for any kind of dealing with Iranian parties, inability to use international insurance services for delivering the goods, inability to use international shipment services for delivering goods, growing misgivings and apprehension of providers and manufacturers about dealing with Iran due to the problems occurring in the process of receiving their money, unwillingness of taking the risk of involving with Iran under sanctions due to the small medical market of Iran compared to American and other countries' vast markets, not selling high-tech medical equipment to Iran for fear of their possible dual [medical and military] usage, and not selling reference medical equipment and precise devices needed for calibration due to dual usages of such technologies. Narrowing the communication platforms led to the termination of old contracts as well.

“The impossibility of using international shipment services and the impossibility of using international insurance services for delivering the goods and equipment have caused severe problems in this respect.” (P6)

(P6).

“Diminishing the trust because of the delays and disruptions in the process of acquiring the revenues of selling equipment to Iran, restrictions over financial transactions, economic sanctions, and inability to uphold financial commitments have led to reduction or termination of any kind of exchange” (P19).

“Due to newly aroused political and military sensitivity over the last years, the issue of not selling high-tech medical equipment and the precise devices used in calibration operations for fear of their potential dual usage has complicated the situation even further, leaving health system in Iran practically deprived of up-to-date technology.” (P13)

#### 1.2) Monetary and interbank transaction

Sanctions have blocked interbank channels and prevented monetary transactions. In the same way, potential negative consequences and punishments threatening any foreign bank involving Iran, cutting off of Iran from SWIFT, and putting sanctions on all Iranian banks are all among the consequences of the sanctions.

“Since the latest round of sanctions in the monetary and interbank transactions were severely affected and henceforth all the banking channels were gradually cut off”. (P15)

“The probability of the realization of threats to punish any bank which transact with Iran has caused foreign banks to have a serious reservation for involving with Iran.” (P31)

“Iran's access to SWIFT was once again cut off as it had been cut off before as well. This has disrupted the procurement of much-needed equipment and has raised the cost of transactions. In addition, putting sanctions on most of the Iranian banks by The US Treasury Ministry has exposed monetary transactions with Iran to maximum risk.” (P31)

#### 1.3) Suppliers, sales representatives, importers, and merchants

Problems caused by such limitations were categorized according to their significance as follows; increase in trading risks, reduction in financial affordance, activity reduction or shutdown, rise in the final cost of foreign products, reduction of competitive power among importers due to the compulsory leaving of the competitors, the absence of reliable brands and restriction of available choices, changing the policy of buying on credit or in installments to buying in cash, and lengthening the process of procurement and delivery and a break in the procurement chain.

“Due to the difficulty of the circumstances for any activ-

Table 2. Themes, sub-themes, and codes related to effects of international sanctions on capital medical equipment in Iran

Themes	Sub-themes	*	Codes
Procurement of capital medical equipment	Capital medical equipment suppliers	1	International brands refrain from cooperation
		2	International brands' termination of the contract for fear of the consequences of trading with Iran
		3	Inability to use international insurance services
		4	Inability to use international shipment service
		5	Trust reduction due to delay in receiving the revenues from selling capital medical equipment
		6	Trust reduction out of the fear of Iran's probable failure in paying for the purchases
		7	Not taking the risk of trade with Iran due to Iran's relatively small market in comparison to The US's
		8	Not selling high-tech equipment for fear of possible dual usage [military and medical]
		9	Not selling reference equipment and precise device used in calibration for fear of their possible dual usage
	Monetary and inter-bank transactions	1	Impossibility of money transaction needed for trading due to the cutting-off of the bank channels
		2	Negative consequences and penalties for the foreign bank for transacting money with Iran
		3	Cutting off from SWIFT
		4	Blacklisting all Iranian bank
	Suppliers, sales representatives, importers of the capital medical equipment	1	Rise in the risk of trade
		2	Decrease in financial affordance
		3	Activity reduction or shutdown
		4	Rise in the cost of imported goods
		5	Reduction of competitive power among importers due to the compulsory leaving of the competitors
		6	The absence of reliable brands and restriction of available choices
		7	Changing the policy of buying on credit or in installments to buying in cash
	The process of procurement of capital medical equipment	1	Equipment procurement policies
		2	Improper backings from IDEM
		3	Central Bank's improper support
		4	Customs' improper support
		5	Disruptions in the distribution and supply network
		6	Bureaucratic interventions from inspection institutions
		7	Disruptions in the procurement chain and its lengthening
	Healthcare providers using capital medical equipment	1	Decrease in financial affordance
		2	Becoming deprived of the reliable brands
		3	Deterioration of the equipment due to inability to replace them
		4	Negative effects on the quality and quantity of services which is, in turn, resulted from disruptions in the procurement chain
		5	Suppliers' unreasonable and unjustifiable postponement of the delivery date of the medical equipment
		6	Dissuasion of the private sector from entering the Healthcare service sector due to lack of cost-effectiveness
7		Inability to properly meet patients' needs with up-to-date equipment and devices	
Service receivers	1	Rise in out-of-pocket costs	
	2	Unreasonable lengthening of the process of providing services	
	3	Cancellation certain services	
	4	Unreasonable rise in the cost of some services	
	5	Rise in the mortality rate	
	6	Reduction in the quality of services	
	7	Probability of referring the patient to other healthcare centers	

ity, one should consider the fact that the total market situation and low-profit margin, as well as the strict regulations, have all affected the activities of the importers and led to national companies' reluctance to continue doing business." (P15)

On the other hand, because of the contradictory policies, procurement and transaction of the needed currency for suppliers have been negatively affected.

"The regulations and laws about importing capital med-

ical equipment have frequently been changing, and this caused a lot of trouble for the health system." (P15)

"Since the sanctions have frozen all Iranian assets, the importers must refer to numerous intermediaries to transfer the currencies. Furthermore, the increase in the risk of trade and fraud of the intermediaries and numerous money transfers to be able to pay for the purchases are critical issues." (P3)

"The sharp and deep devaluation of the national cur-

Table 2. Ctd

Themes	Sub-themes	*	Codes
Repairing and after-sales services of capital medical equipment	Software and spare parts dependent repair	1	Financial disruptions caused by substantial unpaid debts of the health centers
		2	Lack of permission for updating the software of special and high-tech equipment from supplying companies
		3	Unreasonable lengthening of the repairing process when it comes to sending the parts to the manufacturers
		4	Unreasonable rise in the final cost of services
		5	Imposing restrictive regulation by law-making bodies
		6	Hiatus in providing services and doing the repairs due to the accessories and spare parts being stuck in the customs
		7	Manufacturers' refrain from providing distance training
	Specialized human resources dependent repairing	1	Disruption in providing services due to the lack of trained technicians
		2	Hiatus in the process of providing services due to financial disruptions
		3	The impossibility of holding training courses for the Iranian technicians
		4	The unreasonable rise in the cost of repairing and other services
		5	The change of policy to in cash payment for the services
		6	Limitations on the presence of the manufacturers' professional technicians in Iran
		7	Companies' refrain from training Iranian technicians or guide them on how to repair the equipment from distance.
	After-sales services	1	Reduction in the qualitative and quantitative level of after-sales service
		2	Reduction in the effectiveness and efficiency of capital medical equipment
		3	Lack of proper periodic services and calibration of devices
		4	total cessation of after-sales services
		5	Impossibility of upgrading the devices resulted from not selling software licenses to Iran

rency has severely hurt the financial affordance of the importers and critically paralyzed decision-making and foresightedness in procurement chain and curbed the planning potentials for providing optimal services. All this has eventually disrupted the procurement and distribution chain and diminished the companies' general financial capabilities." (P15)

#### 1.4) The process of procurement of capital medical equipment

The process of procurement of medical equipment has been subjected to sanctions from several aspects: equipment procurement policies and acquiring the import license from Iran National Medical Device Directorate [IMED], improper backings from IMED, allocation of the needed foreign currency for import, goods release and clearance from the customs, and bureaucratic interventions from inspection institutions. All this has led to disruptions and therefore prolonging the process of procurement.

"Things like the unpredictability of policies and their perpetual modification by policy-makers, the existence of contradictory and restrictive directives and regulations which are issued irrespective of the conditions resulted from imposing the sanctions have paved the way for deficiencies in policies regarding equipment procurement." (P15)

Additionally, the presence of these contradictory and restrictive regulations and laws that are being issued regardless of the consequences of the sanctions has made it difficult for the private sector to function properly.

"Disproportionate support from IMED and lack of transparency in the process of procurement of equipment are affected by the imposed sanctions and the cumbersome bureaucracy in the process of procurement of the

equipment has pinioned companies. Also, the laws and regulations which are incompatible with sanction conditions have made it practically more difficult for the private sector to function." (P18)

"Erratic changes in the currency exchange rate of the opened LCs, disproportionate allocating of the foreign currency from the Central Bank for procurement of medical equipment, banks' failure to meet their obligations regarding currencies, the MoHME's ambiguities in the allocation of currency for the medical equipment and the strict directives of the Central Bank have led import companies to lower their purchases and equipment manufacturers to move towards using unsubsidized currency and this in its turn has slowed down the process of equipment procurement." (P15)

"All the conditions resulting from sanctions have disrupted the distribution and supply network of medical equipment and paved the way for an increase in unsolicited or even fake medicines. all this has eventually led to a reduction in the quality of services and products." (P5)

The pressure from inspection institutions during the sanction period, especially at the time when sanctions are affecting financial and economic sectors targeting the process of issuing licenses in the related legal bodies, has brought about numerous problems and led eventually to slowing down the process of procurement of capital medical equipment.

"Of the palpable effects of imposing sanctions is lengthening the chain of procurement. That is before the sanctions when an order was made; after a short while, the products were ready for delivery in the custom, but this straightforward process has become tiresomely lengthy. Additionally, it is now impossible to buy without intermediaries and transferring the goods through several coun-

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tries which has inevitably lengthened the procurement process.” (P5)

### 1.5) Healthcare providers using capital medical equipment

Healthcare centers such as hospitals, being affected by the sanctions, have suffered irreparable damages from lack of capital medical equipment. Of the remarkable damages, we can point to the severe financial distress of the healthcare providers, deterioration of diagnosis and treatment equipment due to inability to replace them because of the critical financial distress, direct and indirect, suppliers' unreasonable and unjustifiable postponement of the delivery date of the medical equipment, private sector's lack of inclination to cooperate with service suppliers in providing shared services due to the absence of cost-effectiveness, inability to properly meet patients' needs with up-to-date equipment and devices, and eventually the absence of a rise in the tariffs proportionate to the final cost of equipment, inflation, etc.

“After the sanction was imposed, the government did not consider extra financing, to counter their effects, for providers like hospitals to procure capital medical equipment. This, in turn, has led to a sharp rise in the expenses and consequently, a deep decline in the revenues; and all these have seriously affected the procurement of medical equipment.” (P23)

“Additionally, the noticeable number of unpaid debts from insurance companies has seriously afflicted the hospitals financially. These debts are now collected after one year of delay on average.” (P25)

“The unreasonable and economically abnormal rise in the final cost of the procurement of the equipment due to the blockade of transaction channels and the existence of numerous middlemen in the chain of product procurement are other factors which hurt the financial affordance of Healthcare suppliers especially in treatment sector.” (P3)

“Imposing sanctions has removed the installment purchase option from the table, and the financial distress has obliterated the option of in cash purchase of expensive equipment or even some accessories altogether. This has led to the deterioration of the equipment due to inability to replace them and hence the reduction in the quality of the service these suppliers provide.” (P20)

“Although the pressure of the sanctions has boosted the national production, the intervals among such breakthroughs has had detrimental effects on the quality of diagnosis and treatment.” (P16)

But the sanctions, together with the improper rise in tariffs, which is disproportionate to the present economic conditions, have dissuaded the private sector from entering the Healthcare service sector due to lack of cost-effectiveness.

### 1.6) Service receivers

The rise in the final cost of goods and equipment due to sanctions has, in its turn, raised the final cost of diagnosis services, treatment, and eventually financial strain on the patient.

“Among the negative effects of sanctions are the unrea-

sonable prolonging of the process of providing services and the reduction of the quality of services, and this will have negative effects on the treatment process. In some cases, it results in the cancelation of the surgery or certain diagnostic service and prolonging the patients' stay in the Healthcare centers.” (P5)

## Theme 2. The effects of sanctions on repairing and after-sales services of capital medical equipment in Iran's health sector

The theme is divided into 2 parts; the first of which is explaining the condition where there is a dependency on software and spare parts, and the second of which is explaining the condition where there is no dependency on the spare parts and software but there is one on specialized human resources. In after-sale services, we included installation, launching, acceptance test, calibration, repairing, and spare parts supplying.

### 2.1) Software and spare parts dependence

In software and spare parts dependent category we are dealing with a blatant dysfunction in providing services due to the hiatus in the process which is in turn caused by substantial unpaid debt, lack of permission for updating the software of special and high-tech equipment from supplying companies for fear of penalties and consequences of sanctions, unreasonable lengthening of the repairing process when it comes to sending the parts to the manufacturers, unreasonable lengthening of the repairing process due to the sanctions imposed on shipment and transactions of goods and the disruption in sending and receiving the damaged parts, not allocating subsidized currencies to companies in order to buy spare parts and accessories, unreasonable rise in the final cost of the services, self-imposed sanction, impossibility of the giving up-to-date and necessary instructions and training to technicians due to the withdrawal of some of the manufacturers, disruption in the process of providing services and repairing from some companies because the spare parts and accessories are stuck at the customs.

“Some suppliers do not allow the software of the special and high-tech equipment to be updated because they fear the consequences and penalties of the sanctions, and this has caused some deficiencies in the process of repairing and optimal usage of the capital medical equipment.” (P6)

“In cases where the process of repairing entails procurement of parts and software, the unreasonable lengthening of the process of sending the damaged parts to the manufacturer due to the sanctions on shipment and transfers become really significant.” (P7)

“One of the phenomena resulting from the sanctions is self-imposed sanction. That is, IMED, Central Bank, and the customs pass strict laws and issue restrictive directives which make procurement of accessories and spare parts really difficult.” (P12)

Because of the sanctions, an unreasonable rise in the cost of repairing and providing related services caused by inflation and some suppliers' abuse of the present situation is completely evident in the present conditions.

### 2.2) Specialized human resources dependence

This category highlights several points such as lack of trained technicians, particularly in the field of advanced technologies, hiatus in the process of providing services due to financial disruptions caused by substantial unpaid debts of the health centers, the unreasonable rise in the cost of repairing and providing services resulted from the inflation and some suppliers' unscrupulous abuse of the present conditions, companies' change of policy to in cash payment for services they offer, limitations on the presence of the manufacturers' professional technicians in the country, the impossibility of holding training courses for the Iranian technicians due to some companies' refrain from cooperation, and manufacturers' refrain from cooperation in training Iranian technicians via distance training.

*"Those companies were not in for distance teaching to train Iranian technicians or guide them on how to repair the equipment."* (P4)

*"Along with problems caused by the sanctions, the change of policy to in cash payment for the services was evident in the companies providing services."* (P23)

### 2.3) After-sales services

In the after-sales services category, the following problems were detected: the reduction in the qualitative and quantitative level of after-sales service of certain companies due to the present problems, the reduction in efficiency and effectiveness of the capital medical equipment resulted from the deficiencies in the process of receiving after-sales service, lack of proper periodic services and calibration of devices due to the sanction, some companies' suspension of after-sales service, some companies' refrain from providing after-sales services and regular checks due to the lack of parts and equipment needed for this job and eventually the impossibility of upgrading the devices due to some companies' refrain from selling the software license.

*"Obviously, one of the effects of the sanctions has been the reduction in the qualitative and quantitative level of after-sales service of certain companies."* (P9)

*"On the other hand, the reduction in the effectiveness and efficiency of capital medical equipment which resulted from the deficiency in the process of receiving the after-sales services is evident."* (P9)

*"The limitations on the presence of the professional technicians from manufacturers in Iran and giving in situ services which resulted from the sanctions led to improper services and calibrations or total cessation of after-sales services of certain companies."* (P14)

*"The lack of after-sales services and regular checks from some companies due to sanctions has troubled Healthcare providers but has on the other hand, somehow prompted the national knowledge enterprise companies to manufacture the needed parts for these devices which is of course, a time-consuming process."* (P22)

*"The impossibility of upgrading the devices, which resulted from not selling software licenses to Iran, has led to malfunction and at times failure of medical equipment in the Healthcare providing companies."* (P22)

## Discussion

This study was carried out to investigate the effects of international sanctions on capital medical equipment in Iran. Our findings show that the sanctions have had adverse effects on procurement, repairing, and after-sales services of the equipment. The findings gleaned from interviewing the experts were divided into two themes of the effects of sanctions on procurement of capital medical equipment and the effect of sanctions on repairing and accessing after-sales services of capital medical equipment.

Findings show that interviewees from MoHME, FDA, or private companies, emphasize more on the challenges related to the process of procurement such as transportation and insurance, monetary and interbank transactions and also the limitation of after-sales services caused by sanctions. But the interviewees from hospitals (public or private) and medical equipment department at medical universities emphasizes the challenges of providing services related H.T. medical equipment and their effects on prices as well as the quality of services and also patient confusion.

International manufacturers and suppliers of capital medical equipment mostly have terminated their contracts or suspended their after-sales services for fear of the consequences of the sanctions. Moreover, the impossibility of using insurance and/or shipment services to deliver the products has led to subsequent effects such as limits on the availability of these products or a rise in the final costs. Iran's ability to acquire the needed equipment has diminished, and because Iran's medical equipment market is small in comparison to the US market, for example, they are not ready to risk the latter for the former. This becomes even more problematic when it comes to high-tech medical equipment which might have dual usage [military and medical]. Barzegar Tahamtan and colleagues also highlighted the curbs on the availability of the medicine and medical equipment after sanction imposition (15). Consistent with the result of this paper, Gorji showed that even though medicine is not on the list of sanctions, for fear of targeting pharmaceutical companies, the problems afflicting the shipment of medicine, imposing sanctions on the international banks by the US, the transfer of medicine to Iran is overly complicated. These issues have made some specialty drugs scarce (12).

The other challenge caused by the sanctions is in the financial and interbank transaction sector which, due to cutting off banking channels, access to SWIFT, and fining foreign banks working with Iran, any transaction among the banks is impossible and this, in turn, leads to prolonging the process of procurement of equipment and restrictions on accessing necessary medical equipment. It is also pointed out that if the foreign banks deal with Iranian banks, it is likely that they are blacklisted as well (12). Zakrison and Muntaner also showed that Venezuela's foreign assets were frozen in financial systems outside this country due to the sanctions and this country is cut off from the international banking system (16).

The sanctions also afflicted the Iranian suppliers, importers, and capital medical equipment sales representa-

tives via impacting the general economic conditions, rise in the currency rate, and inflation. These companies have adopted policies like total shutdown, keeping an extremely low profile, or even in cash payment due to heightened risk of the trade, decrease in financial affordance, and the rise in the final cost of imported items which resulted from fluctuations in the currency rate or evading the sanction and other factors. These policies can automatically reduce the need for buying capital medical equipment, and this vicious circle leads to a decrease in these companies' activities. In the previous studies, the Iranian companies and the effect of sanctions on them were not investigated.

According to the interviewees, the sanctions have affected the process of procurement of capital medical equipment in a variety of forms, i.e., procurement policies, Central Bank's support, customs, and IMED have lengthened the supply process. Hosseini and colleagues showed that monetary transactions' difficulties have lengthened the time span of importing medicine and medical equipment (17).

It has also been suggested in Barzegar Tahamtan and colleagues' study that the recent sanctions and the remarkable rise in the currency rate have impacted Iran's foreign trade and, in the health sector, have curbed access to medical equipment (15).

Among those who are significantly affected by the sanctions are the Healthcare providers, especially the ones who deal with capital medical equipment. Being deprived of reliable brands, deterioration of equipment due to lack of access, unreasonable increase in the time it takes to deliver the medical equipment, private sector's reluctance in joining the healthcare-providing sector which in its turn has led to adverse effects on the quality and quantity of the service and lack of timely addressing of the completely new needs of the patient.

Of the important effects of the sanctions on the healthcare providers, especially the services which are dependent on the capital medical equipment, are deterioration of equipment due to inaccessibility of some services, becoming deprived of reliable brands, unreasonable postponement of the delivery date, private companies' reluctance to enter healthcare procurement which in its turn has led to negative effects on the quality and quantity of the service and lack of timely addressing of the completely new needs of the patient. Klunko and colleagues has investigated the problems of the pharmaceutical sector in Russia under sanctions (18). They show that the substitution of special raw material with other brands impaired the colleagues' quality of pharmaceutical products in the country. In Massoumi and colleagues' study, it is underlined that Iran's health system is indirectly affected by the US sanctions and the medicine affordability and availability are reduced (19). Shahabi and colleagues also highlighted the challenges that sanctions posed to providing services. This study deals with the effects of the sanctions on rehabilitation programs, names scarcity of raw material necessary for manufacturing prosthesis and orthosis products, obstruction of the equipment import processes and deficient infrastructures caused by the sanctions as the factors which hinder providing high-quality rehabilitation

services (9). Zakavi and colleagues also showed the reverse effect of the US sanctions on nuclear medicine and patient care (20). Another study which was carried out by Shahabi and colleagues to investigate National Cancer Control Program suggested that sanctions have caused permanent deficiencies and shortcomings in the field of technologies related to preventing, diagnosis, and treatment of different types of cancer and also the scarcity of medication via imposing restrictions on money and product transfer and reducing cash flow and all this has inflicted serious harms towards the vulnerable population, namely those diagnosed with cancer (21).

According to the experts who participated in this study, one of the important sectors of the health system which is affected by sanctions is the most vulnerable one, namely service receivers. Of the effects of sanctions in this field, we can point to the rise in out-of-pocket costs, the unreasonable rise in the cost of service, prolonging the process of providing services, cancelation of certain services, being stranded among several Healthcare centers trying to find a part of the needed service, reduction in the quality of services and the rise in the mortality rate. A study performed in Syria showed that the rise in the costs and the plunge in the national currency resulted from the sanctions have led to the rise in the cost of healthcare and treatment services, particularly the cost of treating NCDs and out-of-pocket money (22). Also, a study carried out in Iraq showed that the sanctions have affected the services and health indexes and brought about maladies like malnutrition, mortality, and a rise in communicable diseases (23). The results of this study are compatible with the results of our study in part pertaining to the rise in mortality rate. Another study which was performed in the same country, shows a decline in the number of surgeries due to the scarcity of anesthetics and surgical supplies (2). Also, the results of a systematic review done by Majdzadeh et al. suggested that there is a reduction in the quality of services or a lack of access to such services due to the lack of access to necessary drugs to treat diseases like cancer, asthma, hemophilia, epilepsy, and NCDs (non-communicable disease) (25). Additionally, Aloosh et al. showed that economic sanctions affect people's mental health and their access to life-saving drugs (26).

The international sanctions have not only affected the procurement of medical equipment but also seriously afflicted the repairing and after-sales services of these items. About the repairing of the medical equipment, challenges like discontinuities in providing services due to considerable unpaid debts of Healthcare centers, supplying companies' refrain from giving permission for software updating for fear of the consequences and penalties of overlooking Iran sanctions, unreasonable prolonging of the repairing time when it comes to sending the damaged parts to the manufacturer or transferring the spare part/s to Iran due to the curbs on the transportation and shipment, not allocating subsidized currency to companies for buying spare parts and accessories, the unreasonable rise in the final cost of services, self-imposed sanctions, the impossibility of giving necessary training to Iranian technicians due to some manufacturers' refrain from cooperating with Iran,

and a hiatus in providing services and doing the repairs due to the accessories and spare parts being stuck in the customs can be pointed out.

Where reparation of medical equipment, replacement of spare parts, and procurement of accessories were not possible due to the sanctions, it seems that the domestic enterprises have tried to recover based on inside potentials. In many such cases, Iranian technicians had been able to deal with the problems. Shahabi et al. have only pinpointed the impossibility of having access to foreign consultants, but the general issue of repair, after-sales service, and periodic services and repairs were left untouched (9). Barzegar has also shown that after the limitations on accessing the medical equipment and accessories, repairing the accelerators has become time-consuming and expensive. Disruptions or delays during a patient's radiation treatment program and a decrease in the therapeutic effects of radiation as well as potential reduction of patients' survival are other adverse effects (15).

### Conclusion

Although the international sanctions imposed on Iran have been the tool to put pressure on this country economically and politically, they have, one way or another, affected the medical equipment sector that deals particularly with diagnosis and treatment of the diseases. They have considerable negative effects on separate phases of the process of procurement, repair, and after-sales services. The sanctions' ultimate effect on vulnerable patients is obvious.

To alleviate the sanctions' effects, Iranian scientists, and experts, relying on national resources, have started to re-manufacture the required spare parts and especially the accessories, and it seems that they have been successful in some areas. However, due to the time needed for re-engineering the parts, subtle differences between the original and the redesigned accessories, and even psychological effects, the sanction has its inevitable negative effects. Hence, the international medical community and other human rights organizations should take serious measures to lift all of it, particularly the ones imposed on the insurances, transferring of goods and transportation, money transfer, interbank transactions and the ones which afflict procurement, repair, and after-sales services of the medical equipment. These actions, hence, will increase the patients' chance of survival, lower out-of-pocket costs and treatment period.

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### Ethical Approval

This article is based on the first author's Ph.D. thesis approved under Code of Ethics IR.ACECR.IBCRC.REC.

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### Conflict of Interests

The authors declare that they have no competing interests.

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