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Economic Evaluation of Using New Medications for Cystic Fibrosis Patients in West Bank, Palestine

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Abstract

Objective: Evaluate the economic burden of cystic fibrosis treatment in Palestine and demonstrate the cost-benefit of introducing new therapeutic options. A willingness to pay survey to assess the patients'/families' ability to contribute to the cost of these new medications was used. Method: A cross-sectional study of CF patients attending pediatric pulmonology clinic at Caritas Baby Hospital (CBH) between January and May, 2017. All healthcare resources used were prospectively documented. Both outpatient and inpatient services were taken into account, the cost of each service was recorded and the percentage of cost reduction after using Dornase-alfa (by 33%) and tobramycin/TOBI® (by 25.5%) based on data from published literature was determined. A willingness to pay survey was added for assessment. Results: The sample consisted of 77 patients from 58 families. 46.75% (36/77) were males and 53.25% (41/77) were females. The mean age was 10.7 years (range: 0.5-36 years). For willingness to pay results; 93.5% answered yes for paying and 6.5% answered no. Of patients who said yes 51.4% are able to pay 100 NIS (~$30) out of pocket, 37.5% are able to pay 50 NIS (~$15), 8.3% are able to pay 500 NIS (~$150) and 2.8% are able to pay 2000 NIS or more (~$570) each month to get new drugs. Of patients 40.3% thought the most important thing they needed was newer equipment for quicker drug delivery and 33.3% of patients thought that providing new medicines that reduce disease symptoms and improve general health were more important. The main reason for patients who did not want to pay (answered no), was poor financial situation. In regards to economical evaluation of CF treatments, the total cost for a CF patient with the mean age of our sample 10.7 years was estimated to be around 35,650 NIS (~$9330) per patient per year. The estimated cost reduction if Dornase-alfa were to be used as a mucolytic and tobramycin as the inhaled antibiotic were 11,765 NIS (~$3361) and 9269NIS (~$2648); respectively, since using these medications is expected to improve their health status and decrease their hospital admissions. Conclusions: The cost of CF healthcare in Palestine is huge considering the socio-economical status of most families. The medications available for them are very basic and there is a lack of newer more effective therapy options that patients and their families demand for better health status.

Keywords: Cystic fibrosis; resources; economic evaluation; willingness to pay

Introduction

Cystic Fibrosis (CF), also called Mucoviscidosis, is a life threatening inherited disease defined by Flume et al., as "a recessive genetic disease characterized by dehydration of the airway surface liquid and impaired mucociliary clearance" [1].

It affects the functioning of several organ systems, which can result in significant discomfort and pain. Due to a defective gene, individuals with CF lack a protein (CFTR) needed to regulate the exchange of salt and water across the cell membrane. This leads to thick, sticky mucus secretions in the respiratory, digestive, pancreatic, and reproductive systems. Over time, thick mucus clogs the bronchi that carry air in and out of the lungs, causing persistent coughing, wheezing, mucus production, inflammation and recurrent infections. Additionally, mucus blocks tubes within the digestive track that carry enzymes from the pancreas to the small intestine. Thus, nutrients are not efficiently absorbed from food, resulting in poor weight gain and growth, abnormal bulky stools frequent greasy, constipation, and intestinal blockage. Females with CF may have difficulty getting pregnant due to thick vaginal secretions and 99% of males with CF are sterile due to blocking of the vas deferens in utero [2]. Also patients with CF diagnosed with electrolyte imbalance particularly in countries with warm weather [3].

The management of CF pulmonary disease requires a multidisciplinary approach with numerous treatment options as daily medical treatment, including physiotherapy and oral and inhaled respiratory medication to minimize deterioration of lung function, and dietary supplementation with pancreatic enzymes and vitamin supplements to prevent mal-absorption [4]. Adoption of these techniques increased the median survival age of patients with CF by 10-fold, from 3 to at least 30 years [5]. The primary cause of morbidity and mortality among CF patients is pulmonary disease caused by the most common bacterial infection Pseudomonas aeruginosa; in 2010, approximately 37.5 % of UK patients were reported to have chronic P. aeruginosa [6, 7].

All over the world, clinical management of cystic fibrosis (CF) has improved during the past years. Increased standardization of care and a focus on maintenance therapies, including nutrition, combined with the introduction of dornase-alfa a mucolytic agent in 1993, tobramycin inhalation solution (TIS) in 1998, and the widespread long-term use of azithromycin (a macrolide antibiotic) have been associated with an approximate 8-year increase in median predicted survival age (increase from 1990 to 2005 to 36.5 years of age) and a 10% increase in median FEV1 percent predicted (from 1990 to 2005) [8].

Novel technology has advanced in many ways to ease the burden of all treatments on CF. It can decrease the administration time and offer better efficacy and safety. These new options are not available in less resourced countries like Palestine; where only basic traditional therapies are being used; for example, hypertonic saline is the only available mucolytic and gentamycin (IV form) is the only available inhaled antibiotic. The lack of new medications like inhaled tobramycin/TOBI® and Dornase-alfa adversely affect the management of these patients and makes it harder to control their disease. The objective of this study is to evaluate the economic burden of CF treatment in Palestine and demonstrate the cost-benefit of introducing these new therapeutic options.

Materials and Methods

All healthcare resources used were prospectively documented for a sample of CF patients attending the pediatric pulmonology clinic at Caritas Baby Hospital (CBH) between January

and May 2017. These patients used basic classic therapies. Around 77 participants completed and provided demographic information. The patient's routine medication was not altered during the study. Both outpatient and inpatient services were taken into account, the cost of each service was recorded and the percentage of cost reduction after using Dornase-alfa (by 33%) [9] and tobramycin/TOBI® (by 25.5%) [10] based on data from published literature was determined. Willingness to pay (WTP) survey was used in this study to examine the patient's preference for the new treatment options and their willingness to pay for them.

WTP is the maximum amount of money that the individual would pay to get the benefits of a service or intervention. WTP will be different between patients depending on the preferences and income. In order for healthcare decision makers to determine to reimburse a certain intervention or treatment the incremental benefits are found, the incremental benefits are the sum that each patient is willing to pay; if the incremental benefits are higher than the incremental costs then the treatment is preferred [11].

WTP questions are either closed-ended question, in which the patients are asked if they would pay a specific amount of money for the health service, the answer will be yes or no, or open ended question, in which the patients can be asked what is the maximum amount they are willing to pay or a payment scale can be used, in which the patients are presented with a scale of possible WTP values [12].

In this study, we asked about their willingness to pay for new therapies with yes or no answer and a payment scale was used in order to ask about the amount of money they are willing to pay for the new medication if they answered yes to first question. Then we asked about the most important factors they want to achieve through their contribution to payment.

The health status, Socio-economic and willingness to pay parts of the questionnaire translated into Arabic and validated by two experts in clinical research and were analyzed using SPSS program.

This study was approved by Caritas Baby Hospital (CBH) Medical Research Committee/Ethical Review Board (approval number: MRC-21). Written informed consents were obtained from the patients and parents (father or mother) of the children involved in this study. All signed informed consent forms were deposited in the patient's hospital medical chart.

Results and Discussion

A total of 77 cystic fibrosis patients (58 families) have participated in this study. There were 46.75 % (36/77) male patients and 53.25 % (41/77) females. The mean age of the patients was 10.7 years (range: 0.5-36 years). Most of the patients were children (6-13 years old). The patients were distributed throughout the different regions of the West Bank (Jerusalem, Bethlehem, Hebron, Ramallah, Nablus, Jenin, Qalqilia, Tulkarem).

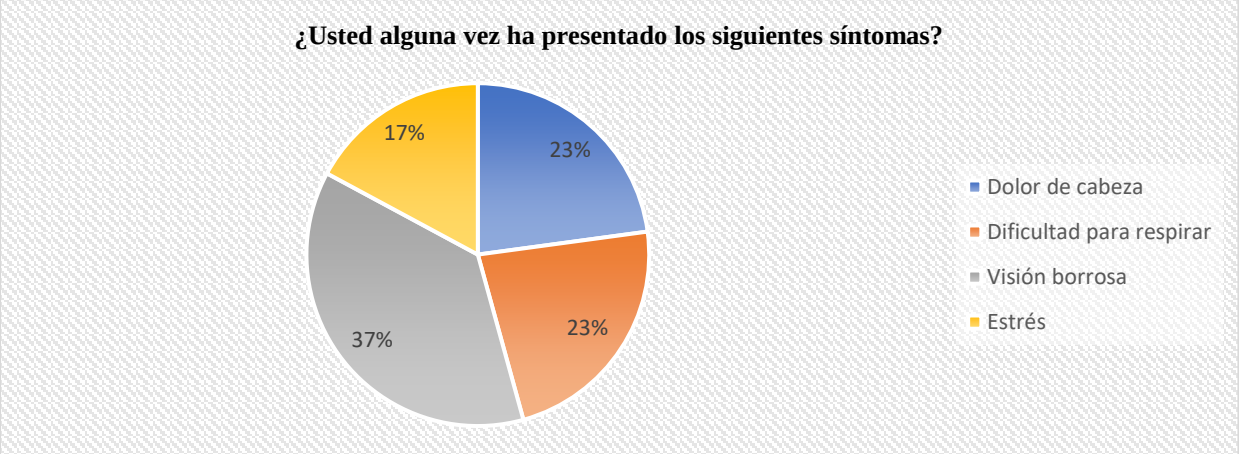
All participants completed the questionnaires without any problems.

Health profile section:

After screening the outpatient medication all patients took Vitamin A&D (Adol®) drops, Tocopherol (Evitol®) tablet, Vitamin K 2mg ampoule, Hypertonic saline (3%, 7%) solution, Creon 10000 IU tablet, Salbutamol 5mg/ml (Ventolin®) nebulized solution, Gentamycin 80 mg ampoule (every other month) and other oral antibiotic.

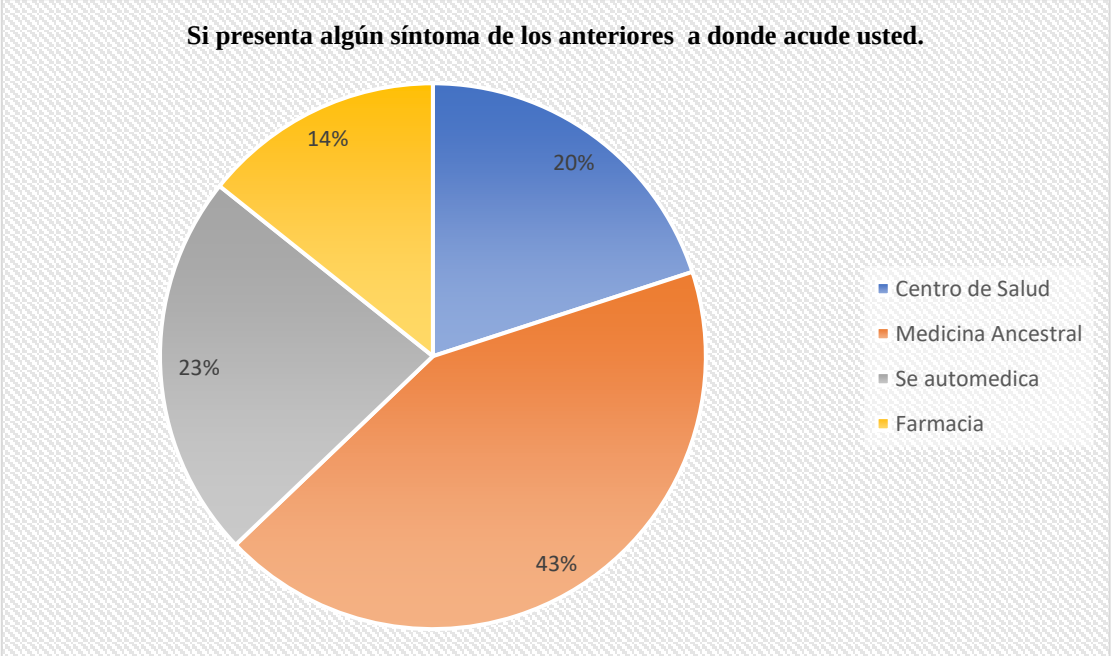
Socio-economic status section;

Chart (1): Different parameter for CF patients



- 74.1% of families have one patient suffer from CF disease, 20.7% having two patients, 3.5% having three patients and 1.7% have four patients as determined below (Chart 2):

Chart (2): Number of CF patients in each family



Health related economic endpoint section

Table (1): Economic endpoint

Health care resources	N	Minimum	Maximum	Mean	Std. Dev.
Monthly use of nebulized antibiotics per year. Hospital admission per year.	77 77	0 0	12 15	5.58 2.99	3.833 2.458
Total inpatient days receiving parenteral antibiotic in hospital.	77	0	21	7.51	6.752
Out patients visits (no. of clinic visits per year).	77	1	12	3.52	3.633
Number of times doing sputum culture test yearly.	77	4	6	4.39	2.537
Number of times doing blood tests yearly.	77	1	2	1.16	.365
Number of times doing radiology exams yearly.	77	1	2	1.04	.195
Monthly productivity loss (No. of days at home due to CF illness per month a).	64	1	30	4.88	6.909
Valid N (list wise) a	64				

- The themes asked about financial situation, support, patients believe about management strategies and mechanism of treatment, and asked about the effect of disease burden on social life, results are demonstrated as following [a] (**Table 2**):
-

Table (2): Themes about the effect of disease burden on CF patients life

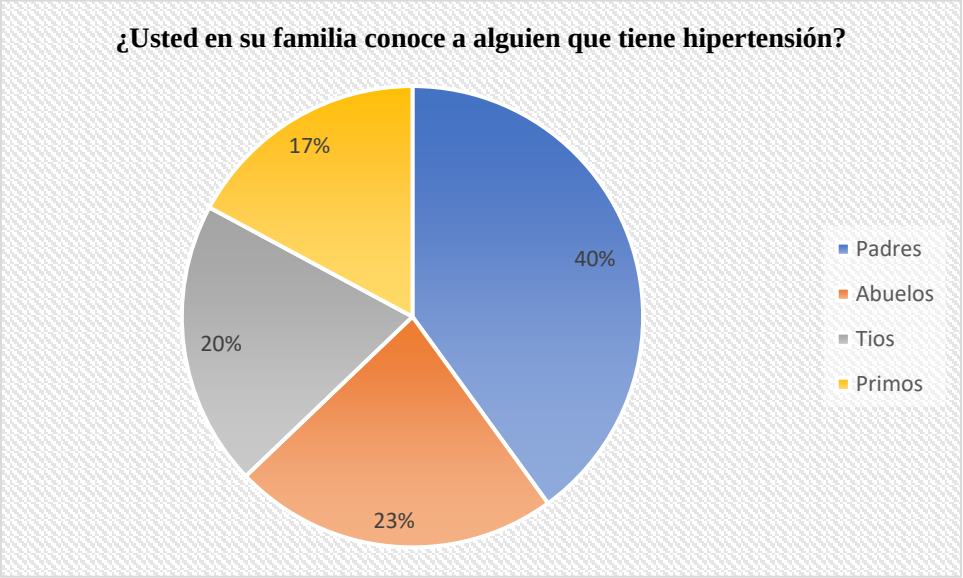
Items [a]	**Themes**	**Always**	**Often**	**Sometimes**	**Never**
Are you thinking about your financial situation?	Financial situation	88.3%	9.1%	2.6%	0%
Do you have confidence that your treatment will be available at all times?	Support and occupation	0%	13%	20.8%	66.2%
Are you satisfied with your access to health services?	Mechanism of treatment	5.2%	9.1%	19.5%	66.2%
Does the treatment currently used affect your social life?	Mechanism of treatment	51.9%	22.1%	23.4%	2.6%
Do you have sufficient financial resources for treatment?	Financial situation	0%	2.6%	28.6%	68.8%

Do you think your current treatment needs to be changed?	Mechanism of treatment	79.2%	15.6%	3.9%	1.3%

a: The data determined by percent of total number of patients 77.

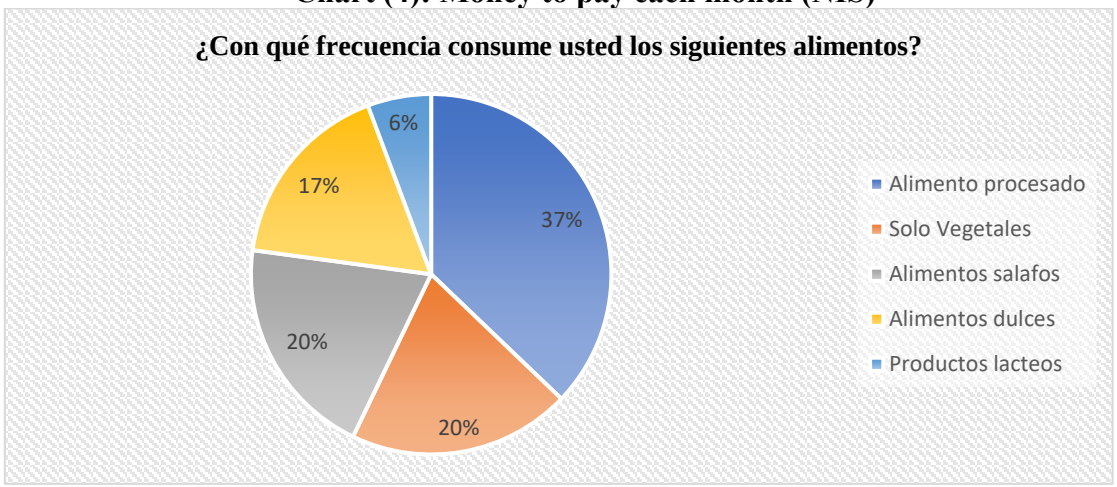
Willingness to pay (WTP) section:
When we told CF families to assume that inhaled TOBI® or CASTON® and Pulmozyme® are a new medications that are available for reducing disease symptom and improving general health in different ways. Keeping in mind their income and household budget, would they have a willingness to pay out of pocket each month to get these new drugs?, 93.5% said yes and 6.5% said no. (the five families said no one of them from adult (14+) group; two from 6-13 group and two from group less than 6 years of age).

Chart (3): Willingness to pay answers



- 51.4% of patients are willing to pay 100 NIS out of pocket each month to get these new drugs, 37.5% are able to pay 50 NIS, 8.3% able to pay 500 NIS and 2.7% able to pay 2000 NIS or more to get these new drugs (Chart 4):

Chart (4): Money to pay each month (NIS)



NIS: New Israel shekel.

- When we asked about the important things they are willing to pay for, the results as following (Table 3):

Table (3): Results about the important things CF families are willing to pay for

	Characteristic	Items	Yes	No	N[a]
1	Providing new medicines reduce disease symptom and improve general health in different ways.	General health status	98.6% (71)	1.4% (1)	72
2	Facilitate the mechanism of treatment by providing modern equipment for treatment.	Mechanism of treatment and time	100% (72)		72
3	Minimize the time it takes to receive the treatment by nebulizer.		100% (72)		72
4	Reduce monthly health related costs by reducing the number of visits and admission to the hospital.	Health related costs/visits	98.6% (71)	1.4% (1)	72
5	Improve the ability to live daily life normally.	Performance	100% (72)		72

N: the number of patients answered the questions. **a**: five of patient answered NO to pay so subtract from the total sample 77. Data demonstrated by percent and frequency.

- Some patients preferred to add comments about things they are concerned about and requested to achieve them:
- The need of medical centers that care for CF patients, help in their treatment and follow up on their status.
- The need of community awareness and education about CF disease.
- Inpatient cases' ages in Caritas baby hospital should be less than 15 years as instructed, which cause a big problem for CF patients older than 15 years and need for hospital admission.
- They request for complete recovery from the disease by a drug that treats the genetic cause of CF disease completely and cure them.
- Change the dosage form of Creon® (pancrelipase, pancreatic enzyme replacement therapy) tablet into drops form for children.
- The need of one dosage form of A, D, E, and K vitamins.

40.3% of patients chose the most important thing they needed is characteristic number 2: Facilitate the mechanism of treatment by providing modern equipment for treatment and 33.3% of patients chose characteristic number 1: Providing new medicines reduce disease symptom and improve general health in different ways, these results described below (Table 4):

Table (4): Rank order of the items by order of importance for the patient:

Number of characteristic		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1	24	31.2	33.3	33.3
	2	29	37.7	40.3	73.6
	4	4	5.2	5.6	79.2
	5	6	7.8	8.3	87.5
	1 + 2	2	2.6	2.8	90.3
	1 + 4	4	5.2	5.6	95.8
	1 + 5	2	2.6	2.8	98.6
	4 + 5	1	1.3	1.4	100.0
	Total	72	93.5	100.0	
Missing	System	5	6.5		
Total		77	100.0		

Table (5): The main reason for patients who do not want to pay (answer No), is poor financial situation and poverty.

Poverty cause		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	5	6.5	100.0	100.0
Missing	System	72	93.5		
Total		77	100.0		

Table (6): The items used for patient saying No for willingness to pay

N: the number of patients answered the questions. a: 72 of patient answered YES to pay so subtract from the total sample 77. Data demonstrated by percent and frequency.

Economic evaluation of using new medications for cystic fibrosis patients in our countries.

Costs of a disease as described in table (7) are divided in direct and indirect costs. For CF the clinical visit, hospital admission, outpatient drug costs (antibiotics, hypertonic saline, Creon, etc.) and laboratory tests are seen as direct costs. Direct non-medical costs include out of pocket expenses for dietary recommendations and travel costs to receive care. The indirect costs include for example productivity losses. Detailed description of direct medical and non-medical cost is described below in Tables 8 to 9. Direct costs appear to account for most expenses of health care in CF patients. Total costs for patient with the mean age of our sample 10.7 years of age were estimated to be around 35650.2 NIS per patient per year.

Table (7): Mean (S.D) medical consumption per patient over 1 year, stratified by outpatient and inpatient (hospital) care and costs.

Type	Health care resources	Mean (S.D)
Direct medical costs	- Inhaled antibiotics therapy (months)	5.58 (3.833)
	- Hospital admission [No.]	2.99 (2.458)
	- IV-antibiotic therapy [days]	7.51 (6.752)
	- Clinic visits [No.]	3.52 (3.633)
	- Sputum culture test [No.]	4.39 (2.537)
	- Blood tests [No.]	1.16 (0.365)
	- Radiographs [No.]	(0.195)
Direct non-medical costs	- Travel costs to receive care	81.033 NIS
Indirect costs	- Productivity loss [No. per month]	4.88 (6.909)

	Items	Yes	No	N[a]
1	Poor financial situation and poverty	100% (5)		5
2	Lack of desire for change		100% (5)	5
3	I see the situation as appropriate		100% (5)	5
4	Get used to the available medications		100% (5)	5
5	Not want to treat at all		100% (5)	5

Direct medical costs burden

Table (8): The payment expenses for CF patients services

Service Branch	Description	Price (NIS)
Laboratory tests	Sputum Culture / Gram Stain	40
	CBC	20
	BUN (Blood Urea Nitrogen)	16
	Creatinine (Serum)	16
	Electrolytes (Na/K - Serum)	20
	CRP (C-Reactive Protein Titer)	25
	Alkaline Phosphatase	16
	GPT/ALT (Alanine Aminotransferase)	15
	GOT/AST (Aspartate transaminase)	15
	PTT (Partial Thromboplastin Time)	24
	PT (Prothrombin Time) / INR	24
	Protein Total (Serum)	16
	Albumin (Serum)	16
	Glucose (Serum)	10
	HbA1C	35
	Vitamin D (Total)	100
	Vitamin E Level	350
	Vitamin K Level	550
	Acid Fast Bacilli test	40
	IgE Level test	60

	Sweat Chloride test	50
	Genetic Analysis (CF Mutations)	2500
Radiology exams	Chest-STANDARD FRONTAL VIEW	20
	Chest-Frontal + lateral	30
Pulmonology clinic services	Pulmonology Clinic - New Visit	70
	Pulmonary function test	800
Inpatient night fees	Pediatrics hospitalization night	170
	ICU hospitalization night	450
	*The escort pays 20 NIS per night	20

- Inpatient services for CF disease

Total inpatient hospital services

- **Chest Therapy Session (cost 25 NIS for each session).**
- **All laboratory tests and radiology exams previously discussed.**
- **Most commonly inpatient medications.**

Creon 10000 IU Capsules
Hypertonic saline 3%, 7% solution for Inhalation
Vitamin K 2 mg Oral - I.M. - I.V. (Konakion®)
Salbutamol 5mg/1ml solution (Ventoline®)
Tocopherol 100, 200 or 400mg Tabs. (Evitol®)
Vitamin A 10.000 I.U. + Vitamin D3 4000 I.U.) / 1 ml "Adol"
Azithromycin 250 mg Cap
Ciprofloxacin 500 mg Tabs
Gentamycin-NaCl- 0.8mg/ml-0.09%-100ml (80mg/BAG)
Ceftazidime 1 g Vial. (Fortum®)
Amikacin 500mg/2ml Vial
Vancomycin 500mg vial
Meropenem (Meronem 1gm IV vial)

Average hospitalization days: 7.51 days
Average hospitalization admission numbers: 2.99

Daily Average Real Cost around 300 NIS
The real cost of the stay around 2400 NIS
Average cost per patient per year around 7200 NIS

Health related economical endpoint for CF patients

Table (9): Total Economical endpoint costs per patient per year in NIS

Main Cost Items	Mean	Cost/Unit	Total Cost	Notes
- Inhaled antibiotics therapy [months]	5.58	5.4 (BID)	± 1900	Gentamycin 80 mg / 2 ml Ampoule Can be obtained free from MOH.
- Clinic visits [No.]	3.52	70	± 280	
- Sputum culture test [No.]	4.39	40	± 176	
- Blood tests [No.]	1.16	1408	± 1634	
- Radiographs [No.]	1.04	30	± 31.2	
- Hospital admission [No.]	2.99	170	± 7200	300*7.51*2.99 = 7200
- Total hospital services [days]	7.51	300 per night		
- Travel costs to receive care	82		±1200	For total 7 times back and forth.

- Drugs:	Cost/Unit	Total cost	Notes
• Adol® drops 10ml (Vitamin A 500 IU & D_3 200 IU).	10 NIS	360	Can be obtained free from MOH
• Tocopherol (Evitol®) 400 mg tablet.	46 NIS	552	Unit of 200 mg form used = 23 NIS
• Vitamin K 2 mg / 0.2 ml oral - I.M.- I.V. (Konakion®).	7 NIS	2520	Must obtained free from MOH
• Creon 10000 IU (100 capsule).	145 NIS	12528	Obtained free from MOH
• Hypertonic saline 3% prepared from 23.4% HTS 230ml.	20 NIS	375.7	Free from Caritas baby hospital only
• Hypertonic saline 7% solution (180ml).	46.8 NIS	1123	Free from Caritas baby hospital only
• Salbutamol (5mg/ml) respiratory solution (Ventolin® solution 20ml).	20 NIS	720	Can be obtained free from MOH
• Azithromycin 250 mg EOD (box of 6 caps).	25 NIS	900	Can be obtained free from MOH
• Other oral antibiotic:	30 NIS	360	Can be obtained free from MOH
1. Augmentin® syrup ES (600mg/5ml).	35 NIS	420	
2. Ciprofloxacin 500mg (15 tablets).	16 NIS	192	
3. Trimethoprim 40mg with Sulphamethoxazole 200mg/5ml (Sulprim® suspension 100ml).	44 NIS	792	
4. Cefuroxime axetil Suspension 250mg/5ml (Zinnat® 100ml)			

No.: number; BID: twice daily; NIS: new Israel shekel; EOD: every other day; MOH: ministry of health.

- **Table (10): Total costs for CF patient 10.7 years of age yearly**

Main Cost Items	Total Cost (NIS) per year

-	Inhaled antibiotics therapy	1900
-	Clinic visits	280
-	Sputum culture test	176
-	Blood tests	1634
-	Radiographs	31.2
-	Sweat Chloride test	50
-	Genetic Analysis (CF Mutations)	2500
-	Total hospital services	7200
-	Pulmonary function test	800
-	Travel costs to receive care	1200
-	Oral antibiotics medications	1782
-	Vitamins and enzymes	15960
-	Airway clearance medications	1123
-	Bronchodilators	720
-	Other medications	294
Total cost = 35650.2 NIS		

- According to pharmaco-economic analysis of aerosol Dornase alfa (rhDNase) drug the reduced costs of RTI-related care are expected to be about 33% (18.3-37.5%) of the total costs [5, 9, 13]. A significant impact on our total health care budget will be seen when introducing this medication to our CF patients, preliminary estimate from this study indicates that if rhDNase could be used, a reduction in the cost-effectiveness ratio can be obtained and costs reduction by 11765 NIS can be estimated. This added value can help in part of the cost for making aerosol Dornase alfa available for CF patients.

- Economic evaluation of Tobramycin nebulizer solution in cystic fibrosis showed that cost offsets may occur through changes in overall patient management with a reduction in the use of other healthcare resources to be about 25.5% of the total costs [10, 14]. A significant impact on our total health care budget will be seen when introducing this medication to our CF patients with costs reduction by 9269.1 NIS can be estimated. This added value can help in part of the cost for making Tobramycin nebulizer solution available for CF patients.

Discussion

We described the clinical characteristics and outcomes of the 77 patients included in the Caritas baby hospital who visited pediatric pulmonology clinic. Our data indicate that the patients with CF followed under study have bad health status, this has been confirmed by the death of two participant one month after we finished the study, a boy at 16 years of age and a girl didn't complete the seven months of her life, they died from their respiratory complication. Our sample was the population sample of CF disease as we took the available CF patients in West Bank. There were nine other CF patients that Caritas was aware of, but three of them refused to participate as they do not acknowledge the existence of the disease and three others cannot be reached because they traveled to other countries for treatment and the other three have not been confirmed as CF yet.

Regarding patients' characteristics, mean age at diagnosis was **4.16** years of age, ranging from <1 to 30 years, and the main clinical manifestations were pulmonary infections, malnutrition

and pancreatic insufficiency, as in other studies; as already known, the late diagnosis results in worse prognosis of CF lung disease [15].

As we see Palestinian CF patients have poor quality of life, this is related to that our treatment regimen for CF is highly complex and time consuming, requiring 2–4 h of treatment every day. The treatment regimen includes multiple inhaled therapies, airway clearance two times per day, oral medications, and boosting calories to 110–200% of the recommended daily allowance. The challenges of adhering to this regimen include the time required, the complexity of using and cleaning the equipment, and its considerable cost. In addition, patients experience frequent pulmonary exacerbations, hospitalizations, and segregation from peers due to multi-resistant bacteria. High rates of depression and anxiety have also been reported by both patients and caregivers.

As we measured in the willingness to pay section, 93.5% answered yes for paying and 6.5% answered no for that. Of patients who said yes 51.4% willing to pay are able to give 100 NIS out of pocket each month to get these new drugs, 37.5% are able to pay 50 NIS, 8.3% able to pay 500 NIS and 2.8% able to pay 2000 NIS or more to get these new drugs. This mean that our patients looking for a solution to their current situation.

In our study, 40.3% of patients chose among the things that were presented to them the most important thing they needed is to facilitate the mechanism of treatment by providing modern equipment for treatment and 33.3% of patients chose to pay in return for new medicines that reduce disease symptom and improve general health in different ways.

After economic evaluation of health care resources use and costs, the total costs of care for CF patient 10.7 years of age were estimated to be around 35650.2 NIS per patient per year as the treatment burden of this disease in the West Bank is very huge and expensive as we discussed. This total cost can be reduced by 33% and 25.5% with administration of Dornase-alpha mucolytic drug and Tobramycin antibiotic drug respectively [9, 10]. According to literature review studies which indicated that by using these drugs, cost offsets may occur through changes in overall patient management with a reduction in the use of total health care resources. The savings obtained from using recommended drug may help offset the cost of adding them to the health care of CF patients.

These results should be interpreted in light of some limitations. First, as a result of the lack of special centers that monitor and deal with CF patients and clarify many clinical aspects and outcomes of CF patients, we had difficulty in obtaining the full number of patients in West Bank and Gaza strip. As well, the sample size, although reasonable for this rare disease, was relatively small for the analyses that were conducted. Thus, this study was likely underpowered to detect some of the predicted relationships.

Second, the lack of a comparison group between our CF patients treated with new medication that we discussed in this study as Dornase-alpha or Tobramycin inhalation solution is a limitation that impairs a complete investigation about the benefits of these new drugs in the West Bank. In view of the current recommendations regarding the use of Dornase alpha or Tobramycin, it was decided to base our data on the literature studies due to high-cost price for these medication and lack of financial and human resources to apply these drugs in the West Bank. Nevertheless, in our study, subjects served as their own controls as clinical information for our CF patients were compared to normative CF international data.

Conclusions:

The cost of CF healthcare in Palestine is huge considering the socio-economic status of most families. In addition, the medications available for them are very basic and there is a lack of newer more effective therapy options. We speculate that the total cost of treatment can be

lowered if new advanced therapeutic options become available. The patients and their families demand better treatments and are also willing to have a co-payment to get them.

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