ORIGINAL ARTICLE

Tuberculosis Trend in Majmaah, Saudi Arabia: A 10 Year Retrospective Study (2005-2014)

Elsadig Y. Mohamed[1], Gopikrishnan Muraleedharan[2], Khaled A. Medan[3], Waqas S. Mahmoud [4], Sawsan M. Abdalla1, Mohamed A Al Mansour[5], Ahmed Khalid Al-Salbud, Abdulkreem Al-Naseer[6]

1 Associate Professor of Community Medicine, College of Medicine, Majmaah University, Saudi Arabia
2 Lecturer in Medical informatics, College of Medicine, Majmaah University
3 Assistant professor of Community Medicine, College of Medicine, Majmaah University, Saudi Arabia
4 Lecturer, Biostatistics, Department of Public Health & Community Medicine, College of Medicine, Majmaah University, Saudi Arabia
5 Assistant professor of Family Medicine, College of Medicine, Majmaah University, Saudi Arabia
6 Student, College of Medicine, Majmah University
Correspondence: Elsadig Yousif Mohamed:College of Medicine, Majmaah University, Saudi Arabia.
Email: ey.mohamed@mu.edu.sa - elsadigoo@gmail.com.Tel. 00966 530748432,
Fax. +966164042318, P.0.Box 66

Received on: 9th October, 2016; Accepted on: 1st Novemberl,2016

Abstract

Objectives: The objective of the current study was to determine the epidemiology and characteristics of tuberculosis in Majmaah, Saudi Arabia during 2005-2014.

Patients and methods:Retrospective observational descriptive study of data obtained from the Tuberculosis Information System. All medical records of tuberculosis patients registered during the study period were reviewed after obtaining the ethical approval. The data were collected by a check list and analyzed by SPSS.

Results:Total TB reported incidence decreased from 8:100,000 to 6:100,000 populations between 2005 and 2014. The reported incidence of the disease was higher (32.8%) among the age group(25 and 34) years.The female gender was mostly affected (52.8%) compared to males. Extra pulmonary and new TB cases were (67.2%) and (98.5%) respectively. Twenty two patients (32.8%) were tested for HIV/AIDS and all of them were negative. Regarding treatment outcome, ten patients (14.9%) cured, 34(50.7%) completed treatment, 15 (22.4%)

الملخص

الأهداف: تمثلت أهداف الدراسة في تحديد وبائية وخصائص مرض الدرن بالجمعة- المملكة العربية السعودية في الفترة من ٢٠٠٥ وحتى ٢٠١٤.

منهجية الدراسة: هّذه دراسة وصفية استرجاعية للدرن بمنطقة المجمعة من واقع السجلات الخاصة بنظم معلومات الدرن . تمت دراسة السجلات الطبية لمرضى الدرن المسجلين خلال فترة الدراسة وهى عشر سنوات بعد الحصول على الموافقة الأخلاقية. تم جمع البيانات عن طريق قائمة المراجعة كما تم التحليل بواسطة برنامج الحزمة الاحصائية للعلوم الاجتماعية.

النتائج: انخفض معدل حدوث حالات الدرن بالمجمعة من ٨:١٠٠٠٠٠ الى ٦:١٠٠٠٠٠ من السكان بين عامي ٢٠٠٥- ٢٠١٤. أوضحت الدراسة أن معدلحدوثالحالات أعلى(٣٢,٨ ٪) في الفئة العمرية (٢٥-٣٤) سنة مقارنة ببقية الفئات العمرية كما أن الاناث هم الأكثر اصابة بالمرض (٥٢,٨ ٪) مقارنة بالذكور. يمثل الدرن خارج الرئة والاصابات الحديثة (٧٦,٢٪) و (٩٨,٥ ٪) على التوالي. تم التحليل لعدد ٢٢ (٣٢,٨ ٪) من المرضى للكشف عن مرض الأيدز حيث أثبت التحاليل أن جميعهم خاليين من

transferred and 4 (6%) defaulted; the death ratio was 6%.

Conclusion:Tuberculosis reported incidence declined in Majmaah, Saudi Arabia during 2005 and 2014: however the diseasereported incidence increased among the expatriates compared to Saudi population. During the study period, tuberculosis was more common among females, younger age groups, illiterates and married population.

Key words: Tuberculosis trends; incidence; retrospective study

المرض. بالنسبة للعلاج وجدت الدراسة أن ١٠(٩,١٤ ٪) شفوا تماماً ٣٤(٧,٥٠ ٪) أكملوا العلاج و١٥(٤,٢٢ ٪) تم تحويلهم بينما ٤(٦ ٪) تخلفوا ولم يكملوا العلاج. معل الوفاة بالنسبة للدرن بالمجمعة هو ٦ ٪.

الخلاصة: انخفض معد لحدوث حالات الدرن بالمجمعة- بالمملكة العربية السعودية خلال ٢٠٠٥-٢٠١٤ الا أن هنالك زيادة ملحوظة في معدل الاصابة بالمرض وسط الأجانب مقارنة بالسعوديين. خلال سنوات الدراسة كانت الاصابة بالدرن أعلى بين الاناث والسكان الأقل عمرا وغير المتعلمين بالاضافة الى المتزوجين مقارنة بنظرائهم.

Introduction

Tuberculosis (TB) is an infectious disease caused by the bacillus Mycobacterium tuberculosis. The disease typically affects the lungs (pulmonary TB) but can affect otherparts of the body as well (extra pulmonary TB) [1]. Despite the availability of highly effective treatment of the disease for decades, TB remains a major global health problem.Globally, there were an estimated 9.0 million incident cases and 1.5 million deaths due totuberculosis in 2013[2], most of the cases were in the South-Eastern Asia, African and Western Pacific regions (35%, 30% and 20%) respectively[3,4]. Tuberculosis is highly prevalent in the Eastern Mediterranean Region; the prevalence rate is estimated at 18:100 000 population 2012[5].

In Saudi Arabia, tuberculosis remains a public health threat despite improved living standards and public awareness, availability of free anti tuberculosis medications, and implementation of BCG vaccination at birth[6]. In 2007, the World Health Organizationestimated the incidence of TB in the Kingdom as 46:100,000 population/year; the incidence of smear positive TB as 21:100 000 populations/ year and the prevalence of all forms of TB as 65:100,000 population/year [7].

During 1991-2010 there were a total of 64,345 reported TB cases in Saudi Arabia, non-Saudis had 2-3 times higher incidence than the expatriates. The disease trend was rising over the first 10 years of the study period then it started to fall slightly. The incidence increased with age, but only people older than 45 years showed a declining trend. Regional variations were observed;Makkah and Jazan regions had the highest incidence rates while rising trend was observed in Makah and the central regions [8].

The kingdom is facing increased trends in resistance to pulmonary tuberculosis treatment [9], a retrospective study was conducted which included patients with culture proven diagnosis of tuberculosis seen at King Khalid National Guard Hospital, Jeddah showedtreatment failure rate as 30.6%. Noncompliance and drug resistance

were considered the main two factors which were significantly associated with treatment failures [10].

In 1992, the Ministry of Health established a National Tuberculosis Control Committee to implement a control program throughout the Kingdom, and in 1999 the MOH implemented the Direct Observed Treatment Short course (DOTS) strategy recommended by the WHO. This strategy was adopted in the kingdom in 1998,and an expansion phase was established to include all the provinces in the year 2000 [11].

In Saudi Arabia there are several institutions providing healthcare for patients with tuberculosis: the National Guard, Military, Security Forces and Ministryof Health hospitals.Patients attending the private sector suspected of having TB are referred to government hospitals [12].

Saudi Arabia under-went a vast economic expansion which led to improving social and health services. This was associated with an influx of up to six million expatriates; most of them were from high burden TB countries such as India, Pakistan, Bangladesh, Indonesia and Yemen. The kingdom is facing increased trends in resistance to pulmonary tuberculosis treatment sine most of the expatriates and pilgrims coming from countries with high prevalence of multi and extensive drug resistance tuberculosis (MDR-TB and XDR-TB) [13,14].

The objectives of the current study were to determine the trends of tuberculosis reported incidence rate in Majmaah, Saudi Arabia during 2005-2014; to determine the relation between tuberculosis trends and the patients'social factorsand to specifytreatment outcome for tuberculosis patients during the study period.

Patients and methods

Study design:

A descriptiveretrospectivestudy to determine thereported incidence trends of tuberculosis in Majmaah, Saudi Arabia in the period 1 January 2005 to 31 December 2014

Study populationand setting:

Majmaah is located in Riyadh region, 180 Km from the capital city of Saudi Arabia. All TB suspects from the area are referred tothe department of pulmonary diseases in KingKhaled hospital, Majmaah.All medical records of tuberculosis patients registered from 2005 to 2014 in the hospital were reviewed and included in this study.The data were verified from the records of King Saud Chest Hospital in Riyadh where all the data of TB patients from Majmaah were kept.

Data collection and analysis:

The data were collected by a pre-tested check list contained social factors(patient's age, gender, nationality and residence). It also includedTB classification, type of treatmentandtreatment outcome. Tuberculosis treatment was assessed according to WHO guidelines.The data collectors weretrained to improve the quality of data collection. The data was edited, cleaned, summarized using a master sheet and doubled entered into the software. The SPSS for Windows

software, version 20 (SPSS, Chicago, Illinois, USA) was employed to analyze the data. Descriptive statistics was used (frequency and standard deviation). Comparisons between groups weremade using the chi-squared test. P value< 0.05 was considered significant and alltests were 2-sided.The ethical approval was obtained from the ethical committee of the Basic Health Research Center, Majmaah University. The data was kept confidential and was utilized only for the purpose of this study.

Results

There were a total of 67 TB cases reported to King Khaled Hospital, Majmaah during 2005-2014. Of these, 10 (14.9%) were from the age group 0-14 years. The age groups (15-24), (25-34), (35- 44) and more than 44 years constituted 16.4%, 32.8%, 13.5% and 22.4% respectively.Most of the cases (89.6%) were illiterate; the others (10.4%) had a general education. Most of the TB cases (56.7%) were from urban areas and more than half (50.8%)were married. Most of the TB patients were Saudi 36 (53.7%); the non-Saudi were 31(46.3%).

Table (2) shows the characteristics of tuberculosis in Majmaah. Most of TB cases 45(67.2%) were extra pulmonary. Pulmonary tuberculosis cases were 22(32.8%). Almost allpatients 66 (98.5%) were new cases;

Table (1). Social characteristics of the TB patients n=67

Social characteristics	No.	Percent
Age/ years:		
0 -14	10	14.9
15- 24	11	16.4
25-34	22	32.8
35-44	9	13.5
More than 45	10	22.4
Gender:		
Male	32	47.8
Female	35	52.2
Education:		
Illiterate	60	89.6
General	7	10.4
Residence:	38	56.7
Urban	29	43.3
Rural		
Marital status:		
Single	25	37.3
Married	34	50.8
Divorced/ Widowed	8	11.9
Nationality:		
Saudi	36	53.7
Non-Saudi	31	46.3

- Mean age in the first five years= 33.7 years
- Mean age in the second five years= 31.1 years
- Total Mean age= 32 years

only one case was a relapse (1.5%).Most TB diagnosis was based on ICT (50.7%), culture (23.9%), sputum (22.4%) and XR (3.0%).Twenty two patients (32.8%) were tested for HIV/AIDS and all of them were negative. Regarding treatment outcome, ten patients (14.9%) cured, 34(50.7%) completed treatment, 15 (22.4%) transferred and4 (6%) defaulted. The death ratio was 6%.

Fig (1) Shows tuberculosis trends in Majmaah during 2005 and 2014. In all,total TB reported incidence decreased from 8:100,000 to 6:100,000 populations. Smear positive TBin 2005 was 2:100,000; no smear positive TB case was reported in 2014.

Table (3) showsTB Trends according to social characteristics between the first and the second five year terms (2005-2009and 2010-2014). Overall, only one case dropped in total between the first and the second terms. The number of tuberculosis patients in the age group 0-34 years increased from 21 to 22 cases while reduces from 13 to 11 cases in the age group 35 years and more. Regarding gender, the number of males remained the same as 16 cases between the years 2005-2009 and 2010-2014. For the females, the number of cases reduced by one case from 18 to 17 cases between the two terms. The number of Saudi TB cases reduced by 50% between the

Table (2).Characteristics of Tuberculosis

Characteristics	No.	Percent
Type of TB:		
Pulmonary	22	32.8
Extra pulmonary	45	67.2
Total	67	100.0
Patient type:		
New	66	98.5
Relapse	1	1.5
Total	67	100
Means of diagnosis:		
ICT	34	
Sputum	16	50.7
Culture	15	23.9
XR	2	22.4
Total	67	3.0
		100.0
HIV status:		
Negative	22	32.8
Not tested	45	67.2
Total	67	100
Treatment outcome:		
Cured	10	14.9
Completed	34	50.7
Transferred out	15	22.4
Defaulted(Loss to follow up)	4	6.0
Died	4	6.0
Total	67	100

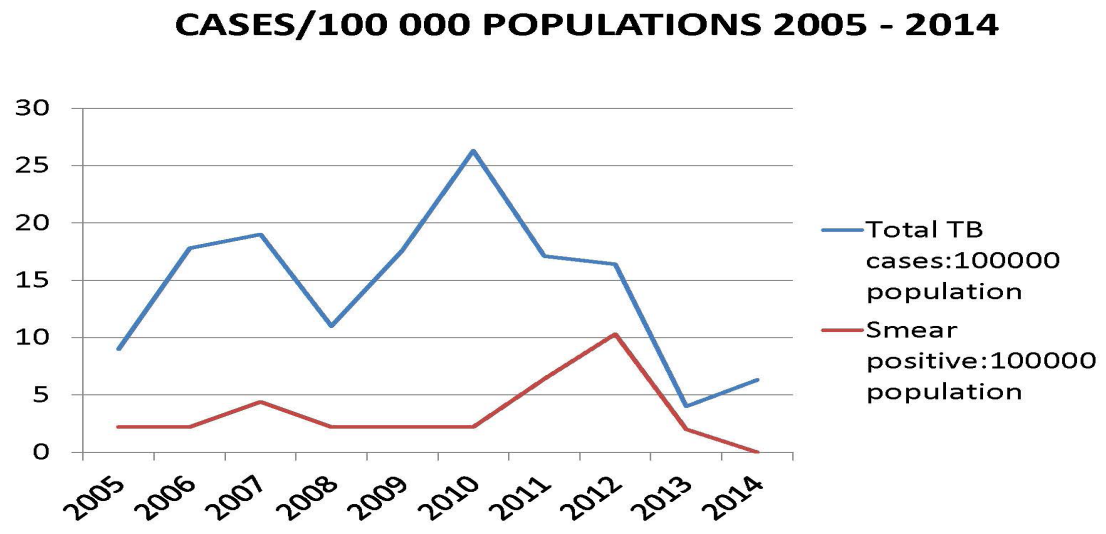


Fig (1) Tuberculosisreported incidence in Majmaah 2005-2014

Table (3). TB Trends according to social characteristics

Social characteristic	Cases/years		Total	p
	(2005-2009)	(2010-2014)		
***Age/ years:**				
Less than 35	21(48.8%)	22(51.2%)	43 (64.2%)	
35 and more	13(54.2%)	11(45.8%)	24(35.8%)	0.4
Total	34 (50.7%)	33(49.3%)	67(100.0%)	
Gender:				
Male	16 (50.0%)	16(50.0%)	32 (47.8%)	
Female	18(51.4%)	17(48.6%)	35(52.2%)	0.84
Total	34(50.7%)	33(49.3%)	67(100.0%)	
Nationality:				
Saudi	24(66.7%)	12(33.3%)	36(53.8%)	
Non-Saudi	10(32.3%)	21(67.7%)	3146.2%)	<0.001
Total	34(50.7%)	33(49.3%)	67(100.0%)	

first and second five years of the study. On the other hand the expatriates TB cases were doubled during the two terms.

Discussion:

Sixty seven cases were diagnosed as tuberculosis by passive case finding in Majmaah area during 2005-2014. The most age group who had the higher reported incidence was between 25 and 34 years while the mean agewas 32 years. The mean age of tuberculosis according to this study was less for the second term compared to the first term; this indicates that the disease is moving towards the young generations.This finding is in line with the global trend of the disease[15]. The males were more affected by the disease compared to females (52.2% Vs 47.8%). This

finding supports studies conducted in Spain, India and Saudi Arabia [16.17, 18, 20].

Most TB cases reported during the study period were extra-pulmonary. This finding is in line with Alrajhi et al whoconducted a study in King Faisal Specialist hospital and Research Centreand reported higher prevalence of extra-pulmonary tuberculosis of 58% compared to pulmonary tuberculosis[21]. It also agrees with W.H.O. that the western part of the gulf region, which includes Saudi Arabia, has a high prevalence of extra-pulmonary tuberculosis[22]. However; it contradicts TB trends in Iran and Quatar[23,24]. This fining also contradicts Al-Orainey I et al who found that most cases of TB (73%) in Saudi Arabia were pulmonary tuberculosis[25].Presence of extra pulmonary TB is of lower epidemiological importance since the infection is confined to the patient and can't be transmitted to others.

Almost all TBpatients according to this study were newcases. This finding is in agreement with studies elsewhere [26, 20]. According to this study, treatment success rate was low (65.6%). Sammana Y et al and Al-Hajoj S.et al reported higher success rate as 81% and 69.4% in Saudi Arabiarespectively[27, 12]. Fifteen patients (22.4%) were transferred out. This high rate of transfer may be due to the fact that patients who were diagnosed as tuberculosis were transferred out of the country after initiating treatment. In this analysis no patient was recorded as treatment failure. All TB patients who were tested for HIV were negative 22 (32.8%): However 45 (67.2%) patients were not tested. In Saudi Arabia the prevalence of HIV among TB patients was 3.3%. Screening for HIV in tuberculosis patients remains underutilized despite the increase of HIV/ AIDS among Saudi nationals [21, 28]. The death ratio from all forms of TB in this study was 6% which was the same as reported by others [29, 20].

The prevalence of TB during the study period did not exceed in any year the national prevalence of the disease which is around 18:100,000 populations that classify the kingdom as an average TB burden country[8,30]. This trend is in line with a decrease incidence in Riyadh region of Saudi Arabia between 2000-2009[18]. This decline is also in line with the global trend of tuberculosis since the year 2000 [19] Contrary to our findings, Gleason JA reported an increase incidence of the disease all over the kingdom including the central region which showed a significant risefrom 6.4 to 14.2/100,000 over 1991 and 2010[31]. It also contradicts Al Hajooj S et al who found that the disease showed an upward trend among both Saudi and non-Saudi population [20, 12].

In general the decline trend of the disease among Saudi and increase trend among non-Saudi ($\pi <$ ٠,001) is consistent with TB trends in Saudi Arabia shown by Al-Orainey et al [25]andAbouzeid MS et al [18] This may be explained by the fact that most of the non-Saudi working force is coming from high TB burden countries[18].

Conclusion:

Tuberculosis reported incidence was declining in Majmaah, Saudi Arabia during 2005 and

2014: however the disease is increasing among the expatriates. The diseasewas more common among the females, the younger age groups, the illiterates and the married population. Most of TB cases were extra-pulmonary and almost all were new. The treatment success rate was low.All TB patients presented to the health services and tested forHIV were negative: However most of the cases were not tested for HIV.

Acknowledgement:

The authors would like to acknowledge the Deanship of Scientific Researchas well astheBasic and Health Research Center, Majmaah Universityfor supporting this work. We would like to acknowledge King Khaled hospital in Majmaah for their support.

Financial support and sponsorship:

This work was supported by the Deanship of ScientificResearch, Majmaah University, Saudi Arabia.

Conflicts of interest:

There are no conflicts of interest regarding this research

References:

1. K. Park. Park's textbook of preventive and social medicine. 20th edition. India: M/s Banarsidas Bhanot publishers. 2009:159
2. World Health Organization (WHO) 2014. Global tuberculosis report 2014. WHO/ HTM/ TB/ 2014.8, Geneva, Switzerland: WHO, 2014
3. WHO 2009. 13thannual report on global control of tuberculosis. Global tuberculosis control epidemiology, strategy and financing. WHO/HTM/ TB/2013.411. Geneva: WHO, 2009
4. Dye C, Maher D, Weil D, Espinal M, Raviglsone M. Targets for global tuberculosis control. Int J Tuberc Lung Dis. 2006; 10:460-2
5. World Health Organization (WHO) 2013. Global tuberculosis report, 2013.WHO/ HTM/TB/2013.11, Geneva, York, Paris: WHO, 2013
6. Al-Hajaj MS, Pandya L, Mari AA, Madani A, Al-Sharif N, Almajed S. Pulmonary tuberculosis in Saudi Arabia: a retrospective study of 1566 patients. Ann Saudi Med. 1991
7. World Health Organization (WHO) 2007. Global tuberculosis control report 2007. WHO/HTM/TB/2007.11. Geneva, New York and Paris: WHO, 2013
8. Al-Orainey I, Alhedaithy MA, Alanazi AR, Barry MA, Almajid FM. Tuberculosis incidence trends in Saudi Arabia over 20 years: 1991-2010. Annals of Thorathic Medicine 2013; 8 (3): 148-152
9. Khan MY, Kinsara AJ, Osoba AO, Wali S, Samman Y, Memish Z. Increasing resistance of M. tuberculosis to anti-TB drugs in Saudi Arabia. Int J Antimicrob Agents. 2001; 17(5):415-8.
10. Al-Hajoj S1, Varghese B, Shoukri MM, Al-Omari R, Al-Herbwai M, Alrabiah F, et al. Epidemiology of anti-tuberculosis drug resistance in Saudi Arabia: findings of the first national survey. Antimicrob Agents

Chemother. 2013 May; 57(5):2161-6.
doi: 10.1128/AAC.02403-12. Epub 2013 Mar 4

11. Heldal E, Kuyvenhoven JV, Wares F, Migliori GB, Ditiu L, Fernandez de la Hoz K, et al. Diagnosis and treatment of tuberculosis in undocumented migrants in low- or intermediate-incidence countries. Int J Tuberc Lung Dis.2008; 12:878–888
12. Al-Hajoj SA. Tuberculosis in Saudi Arabia: Can we change the way we deal with the disease? Journal of Infection and Public Health 2010: 1-8doi: 10/1016/ jjiph.2009.12.001

From: http://www.researchgate.net/ publication/45628794

13. Wilder-Smith A, Foo W, Earnest A, Paton NI. High risk of Mycobacterium tuberculosis infection during the Hajj pilgrimage. Trop Med Int Health 2005; 10:336-339
14. Al-Orainey IO. Tuberculosis infection during Hajj pilgrimage: The risk to pilgrims and their communities. Saudi Med J 2013; 34: 676-80
15. World Health Organization (WHO) 2006. Tuberculosis fact sheet number 104 (updated October 2015).

From: http://www.who.int/mediacentre/ factsheets/fs104/en (Accessed on10.11.2015)

16. Cruz-FerroE, Ursúa-DíazMI, Taboada-Rodríguez JA,Hervada-Vidal AX, Anibarro L, Túñez V. Epidemiology of tuberculosis in Galicia, Spain, 16 years afterthe launch of the Galician tuberculosis program.Int J TuberLung Dis 2014; 18(2):134–140
17. Sharma SK, Goel A, Gupta SK, Mohan K, Sreenivas V, Rai SK, et al. Prevalence of tuberculosis in Faridabad district, Haryana State, India. Indian J Med Res. 2015; 141(2):228-35.
18. Abouzeid MS, Zumla AI, FelembanSh, Alotaibi B, Grady JO and Memish ZA. Tuberculosis Trends in Saudis and Non-Saudis in the Kingdom of Saudi Arabia – A 10 Year Retrospective Study (2000–2009). PLoS One. 2012; 7(6): e39478. doi: 10.1371/journal.pone.0039478
19. World Health Organization (WHO) 2015. Health in 2015: from MDGs, Millennium Development Goals to SDGs, Sustainable Development Goals. WHO/HTM/ TB/2015.114, Switzerland and France: WHO, 2015

From: www.who.int/about/licensing/ copyright_form/en/index.html

20. Al-Hajoj S, Varghese B. Tuberculosis in Saudi Arabia: the journey across time.

J Infect Dev Ctries 2015; 9(3):222-231.

21. Alrajhi AA, Nematallah A, Abdulwahab S, Bukhary Z. Human immunodeficiency virus and tuberculosis co-infection in Saudi Arabia.East Mediterr Health J. 2002; 8(6):749-53.
22. World health organization (2013) Global tuberculosis Report 2013. Geneva: WHO. WHO/HTMTB/2013.11 From:http:// apps.who.int/iris
23. Abu Khattab M, Khan FY, Al Maslamani M, Al-Khal AL, El GendyA, Al

Soub H, et al. Pulmonary and Extra Pulmonary Tuberculosis in Qatar: A First Retrospective Population-Based Study. Advances in Infectious Diseases 2015; 5:148-153 http://dx.doi.org/10.4236/aid.2015.54018

24. Babamahmoodi F, Alikhani A, Charati JY, Ghovvati A, Ahangarkani F, DelavarianL,et al. Clinical Epidemiology and Paraclinical Findings in Tuberculosis Patients in North of Iran.BioMed Research International 2015l; Volume 2015: 1-5 http://dx.doi.org/10.1155/2015/381572
25. Al-OraineyI, Alhedaithy MA, Alanazi AR, Barry MA, and Almajid FM. Tuberculosis incidence trends in Saudi Arabia over 20 years: 1991-2010. Ann Thorac Med. 2013 Jul-Sep; 8(3): 148–152. doi: 10.4103/1817-1737.114303
26. Liew SM, Khoo EM, Ho B K, Lee YK, Mimi O, FazlinaMY,et al.Tuberculosis in Malaysia: predictors of treatment outcomes in a national registry The International Journal of Tuberculosis and Lung Disease 2015;19 (7): 764-771
27. SammanaY, Krayema A, Haidara M, Mimesha S, Osobab A, Al-MowaalladbA,et al. Treatment outcome of tuberculosis among Saudi nationals: role of drug resistance and compliance. Clinical Microbiology and Infection 2003; 9 (4): 289–294
28. Mazroa MA, Kabbash IA, Felemban SM, Stephens GM, Al-Hakeem RF, ZumlaAI,et al. HIV case notification rates in the Kingdom of Saudi Arabia over the past decade (2000-2009). PloS one 7: e45919.
29. Abouzeid MS, Al Hakeem RF, Memish ZA. Mortality among tuberculosis patients in SaudiArabia (2001-2010).Ann Saudi Med 2013; 33(3): 247-252 DOI: 10.5144/0256-4947.2013.247
30. Varghese B, Al-Omari R, Al-Hajoj S. Inconsistencies in drug susceptibility testing of Mycobacterium tuberculosis: Current riddles and recommendations. Int J Mycobacteriol. 2013; 2: 14-17
31. Gleason JA, McNabb SJ, Abduljadayel N, Abouzeid MS, Memish ZA. Tuberculosis trends in the Kingdom of Saudi Arabia, 2005 to 2009. Ann Epidemiol. 2012;22(4):264-9. doi: 10.1016/j.annepidem.2012.01.007. Epub 2012 Feb 24.