

*Original Research Article*

# Knowledge, Attitude and Practice of Hyperbaric O<sub>2</sub> Therapy in the Treatment of Chronic non-healing Wounds among Physicians

J. M. Darandari<sup>1\*</sup>, S. K. AlDahi<sup>2</sup> and F. Farahat<sup>3</sup>

## Abstract

<sup>1</sup>Prince Sultan Armed Forces Hospital,  
Taif, Saudi Arabia

<sup>2</sup>Preventive Medicine Department,  
King Salman Armed Forces Hospital,  
Tabuk City, SA

<sup>3</sup>Community Medicine, Alhada Armed  
Forces Hospital, Taif.

\*Corresponding Author's E-mail:  
[j.darandari@ausdoctors.net](mailto:j.darandari@ausdoctors.net)

Hyperbaric Oxygen (HBO<sub>2</sub>) Therapy has been used for several decades as an adjunctive treatment to standard care for chronic non-healing wounds. However, very little is known about the factors that influenced physicians use of this mode of therapy in their practice. 1st: To assess Physicians Knowledge, Attitude and Practice of HBO<sub>2</sub> Therapy in the treatment of chronic non-healing wounds among physicians, whose practice included wound care, in the Saudi Armed Forces Hospitals during the year 2008. 2nd: To identify the factors associated with their Knowledge, Attitude and Practice of HBO<sub>2</sub> Therapy. 110 Physicians participated in a Cross sectional study with an analytical component. Data collection tool was 21-item questionnaire. All of the 110 physicians participated in the study. The results showed that Practice of HBO<sub>2</sub> Therapy was adopted by only a minority (7.3%; 95% C.I = 3.7 – 13.7) of Physicians who were concentrated in the eastern province. This was despite that the majority of physicians had a high Knowledge (76%; 95% C.I = 76.4–83.5) and agreed (61.9%; 95% C.I = 52.4–70.6) with the use of HBO<sub>2</sub> Therapy. Physicians Knowledge was significantly associated with the dependence on various sources of information to stay informed about the evidence of wound care treatment. Physicians Attitude towards HBO<sub>2</sub> Therapy was significantly associated with their Knowledge (P <0.05). Physicians Practice of HBO<sub>2</sub> Therapy was significantly associated with Patients voluntary request of HBO<sub>2</sub> Therapy (P= 0.006), Symposia was a source of information to stay informed about the evidence of wound care treatments (P= 0.007). The low level of Physicians Practice, in contrast to their high Knowledge of and Attitude towards, HBO<sub>2</sub> Therapy in the treatment of chronic non-healing wounds, in the Saudi Armed Forces Hospitals, was mainly due to the unavailability (except in Jubail) and inaccessibility of HBO<sub>2</sub> Therapy despite the availability of multiplace HBO<sub>2</sub> Chambers. It is suggested that Policy procedures and protocols for use of (or referral for) HBO<sub>2</sub> Therapy to be implemented. Also educating both Patients and Physicians and focusing on cost-effectiveness most probably will encourage future use of HBO<sub>2</sub> Therapy.

**Keywords:** Hyperbaric Oxygen Therapy, Transcutaneous Oxygen Tensions, Diabetic foot ulcer, chronic non-healing wounds, Attitude towards hyperbaric oxygen therapy, practice of hyperbaric oxygen therapy, diffusion of innovation

## INTRODUCTION

There is a low utilization of Hyperbaric Oxygen (HBO<sub>2</sub>) therapy by physicians in the Saudi Armed Forces Hospitals, for the treatment of chronic non-healing wounds, despite the availability of multiplace Hyperbaric O<sub>2</sub> Chambers. Despite growing evidence regarding its efficacy, HBO<sub>2</sub> Therapy use in wound care still seems to

be limited in U.S.A (Guo et al., 2005). Could this low utilization of HBO<sub>2</sub> therapy resulted from physicians lack of knowledge, attitude; or lack of robust clinical efficacy evidence secondary to the poor quality of HBO<sub>2</sub> Therapy study designs (e.g. small sample size)?

Chronic wounds all begin as acute wounds. Chronic

wounds are generally defined as those that fail to progress through an orderly sequence of repair in a timely fashion (Eaglstein and Falanga, 1997; Grey and Enoch, 2006). Those ulcers not showing a reduction in size in a one-month treatment period with good pressure reduction and ulcer therapy can be classified as non-responders (Mulder, 2001). All share the common problem of tissue hypoxia (low tissue oxygen level, usually related to impaired circulation) (Under Sea and Hyperbaric Medical Society, n.d). The dressings for the entire healing process are long gone (Krasner and Sibbald, 1999; Khan and Steinberg, 2004). It is, therefore, important to determine how patients with diabetic foot ulcers and the podiatrists who treat them perceive and understand foot ulceration, as this may influence patient's behaviors (Searle et al., 2005). Hyperbaric oxygen therapy involves the patient to breathe 100% oxygen intermittently (Pennefather J, 2002; Hart, 1999; Kindwall, 1999). It is considered the most benign of all the medical treatments carried out in hospitals where the complications and side effects are very rare (Kindwall, 1999). The overall Prevalence of diabetes mellitus in adults in Saudi Arabia is 23.7% (Al-Nozha et al., 2004) (another 50% of patients with diabetes are undiagnosed). The overall prevalence of diabetic foot lesions among diabetic patients is 10.4% and 66% need surgical debridement with prolonged dressing while 34.1% of patients end with amputations (Sulimani et al., 1991).

**Benefit Analysis:** A systematic review of randomized studies comparing the effect on chronic wound healing of therapeutic regimens which included HBO<sub>2</sub> therapy with those that excluded HBO<sub>2</sub> therapy assessed the benefits and harms of adjunctive HBO<sub>2</sub> therapy for treating chronic ulcers of the lower limb (diabetic foot ulcers, venous and arterial ulcers and pressure ulcers). Five trials contributed to this review. Diabetic foot ulcer (4 trials, 147 patients): Pooled data of three trials with 118 patients showed a reduction in the risk of major amputation when adjunctive HBO<sub>2</sub> therapy was used, compared to the alternative therapy [Relative Risk (RR) 0.31, 95% Confidence Interval (C.I) 0.13 - 0.71]. [Number Needed to treat (NNT) 4, 95% C.I 3 – 11] (Kranke et al., 2004).

In diabetic patients with chronic foot ulcers peri-wound *Transcutaneous Oxygen Tensions* over 400 mmHg in 2.5 ATA hyperbaric oxygen or over 50 mmHg in normobaric pure oxygen predict healing success with high accuracy using HBO<sub>2</sub> therapy as an adjunctive treatment (Niinikoski, 2004).

A systematic review, an economic analysis of controlled studies using a decision model, compared the

cost-effectiveness of adjunctive HBO<sub>2</sub> therapy for Diabetic Foot Ulcers (DFU) with standard wound care alone for the treatment of 65-year-old patients. The authors concluded that HBO<sub>2</sub> therapy as an adjunct to standard care for the treatment of DFUs was a cost-effective treatment in the Canadian health care setting. The study results support the implementation of HBOT in Canada (Chuck et al., 2008).

## MATERIALS AND METHODS

This is a cross-sectional study to evaluate the Knowledge, Attitude and Practice of Hyperbaric O<sub>2</sub> therapy in the Treatment of chronic non-healing wounds and to identify the associated factors among physicians in the Armed Forces Hospitals of Saudi Arabia. The study was conducted at: Kingdom of Saudi Arabia, Ministry of Defence and Aviation; All the large Armed Forces Hospitals (Riyadh, Tabuk, Jeddah, Alhada, Dhahran Complex) and Jubail Hospital, which was employing the Hyperbaric O<sub>2</sub> therapy till the time of writing this research. The study sample included 110 physicians working in the Armed Forces Hospitals, whose current practice include wound management *Statistical Analysis of the Data:* (SPSS version 16).

### Data collection and ethical consideration

The study was approved by the Training and Research Department within the Medical Services Directorate (MSD) of the Ministry of Defence and Aviation (MODA), consent from the Security Department.

## RESULTS

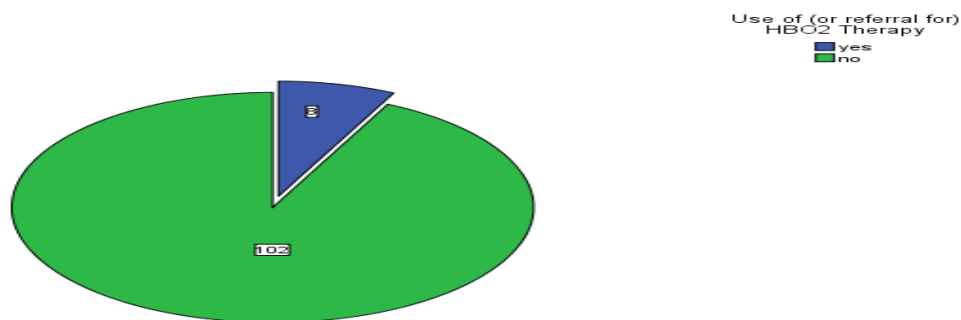
Descriptive result included the Socio-demographic Characteristics of all the participating 110 Physicians. The response rate was considered more than 95%. (Table 1)

## DISCUSSION

Only 8 (7.3%) out of 110 Physicians who participated in the survey used HBO<sub>2</sub> therapy (figure 1). This was due to the fact that the practice of HBO<sub>2</sub> therapy was concentrated in the Eastern Province of Saudi Arabia, 1

**Table 1.** Demographic and Job characteristics of the Physicians, participated in the study (n = 110).

Variable	NO.	(%)
<b>Age (years):</b>		
<31	31	(28.2)
31-40	33	(30.0)
41-50	33	(30.0)
51-60	12	(10.9)
Missing	1	(0.9)
<b>Gender:</b>		
Male.	88	(80.0)
Female.	21	(19.1)
Missing.	1	(0.9)
<b>Medical Practice (years):</b>		
<6	28	(25.5)
6-10	24	(21.8)
11-15	6	(5.5)
16-20	22	(20)
21- 25	19	(17.3)
26-30	6	(5.5)
>30	2	(1.8)
Missing	3	( 2.7)
<b>Major Medical Specialty:</b>		
Diving and Hyperbaric Medicine.	4	(3.6)
General Surgery.	37	(33.6)
Plastic Surgery.	4	(3.6)
Vascular Surgery.	7	(6.4)
Family Medicine.	40	(36.4)
Home Health Care.	6	(5.5)
Other.	11	(10.0)
Missing.	1	(0.9)

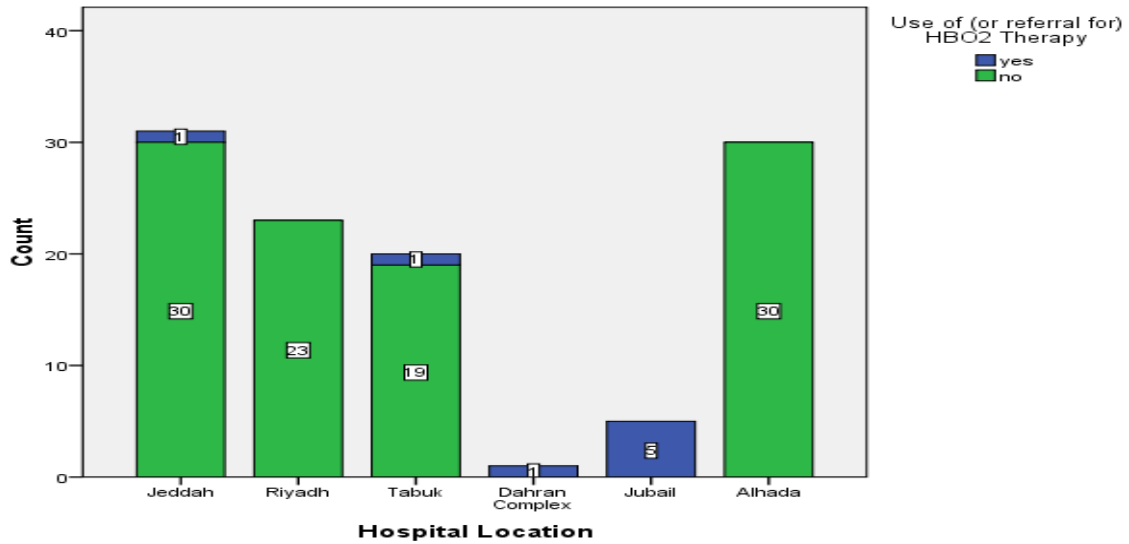
**Figure 1.** Physicians Users and Non-users, participated in the study, of HBO<sub>2</sub> therapy in the treatment of chronic non-healing wounds (n=110).

Physician in Dhahran and 5 Physicians in Jubail (figure 2).

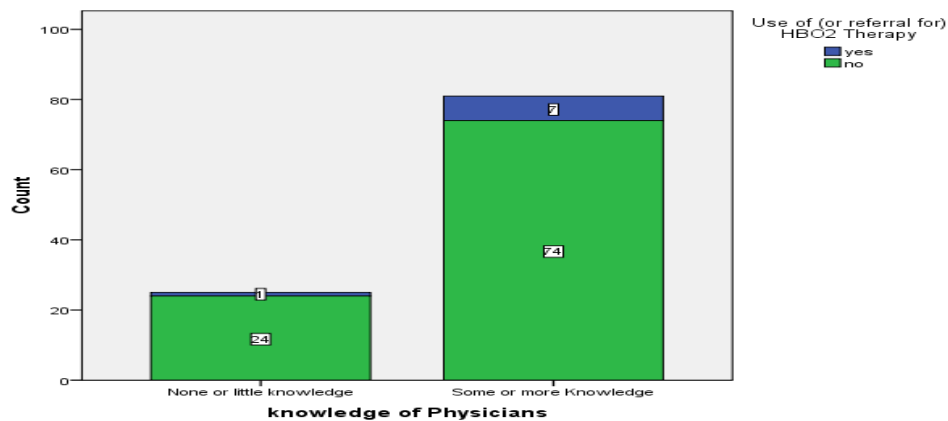
The percentage of physicians who had "some or more Knowledge" of HBO<sub>2</sub> therapy in the treatment of chronic non-healing wounds among physicians was relatively high (76.2%) reflecting that the first step in the process of diffusion of new technology/innovation has already started among the Physicians in the Saudi Armed

Forces Hospitals (figure 3 and table 2).

Knowledge was also significantly associated with physicians' dependence on various sources of information to stay informed about the evidence of wound care treatment. Scientific Medical Journals (table 3). Clinical Guidelines (table 4). The Internet Base of Continuing Medical Education, Peers, Traditional concentrated in the Eastern Province of Saudi Arabia, 1



**Figure 2.** Number of Physicians, participated in the study, ( users of or referrers for ) and number of non-users of HBO<sub>2</sub> therapy in the treatment of patients with chronic non-healing wounds as a function of Hospital Location (n=110).



**Figure 3.** Physicians (users and non-users, participated in the study). Knowledge of HBO<sub>2</sub> therapy in the treatment of chronic non-healing wounds (n=110)

**Table 2.** Physicians Knowledge of HBO<sub>2</sub> therapy in the treatment of chronic non-healing wounds as a function of Gender (110).

Gender	Knowledge of Physicians		
	None or little knowledge	Some or more Knowledge	Total
Male	16 (18.8)	69 (81.2)	85 (100.0)
Female	9 (45.0)	11 (55.0)	124 (100.0)
Total	25(23.8)	80(76.2)	105(100.0)

Chi-sq = 6.115 df = 1 P = 0.013

**Table 3.** Physicians knowledge of HBO<sub>2</sub> therapy in the treatment of chronic non-healing wounds as a function of Scientific Medical Journals (as a source of information), n =110.

Scientific Medical Journals	Knowledge of Physicians		
	None or little knowledge	Some or more Knowledge	Total
Never	8(80.0)	2(20.0)	10(100.0)
Rarely	5(33.3)	10(66.7)	15(100.0)
Occasionally	0(0.0)	6 (100.0)	6(100.0)
Fairly Often	4(11.4)	31(88.6)	35(100.0)
Very Often	1(8.3)	8(52.9)	12(100.0)
Total	25(23.6)	81(76.4)	106(100.0)

Chi-sq = 23.038 df = 4. P = 0.000

**Table 4.** Physicians Knowledge of HBO<sub>2</sub> therapy in the treatment of chronic non-healing wounds as a function of Clinical Guidelines (as a source of information), n=110.

Clinical Guidelines	Knowledge of Physicians		
	None or little knowledge	Some or more Knowledge	Total
Never	7(63.6)	4(36.4)	11(100.0)
Rarely	3(30.4)	16(69.6)	34(100.0)
Occasionally	3(8.8)	31(91.2)	34(100.0)
Fairly Often	4(16.7)	20(83.3)	24(100.0)
Very Often	3(23.1)	10(76.9)	13(100.0)
Total	24(22.9)	81(77.1)	105(100.0)

Chi-sq = 15.443 df = 4 P= 0.004

Physician in Dhahran and 5 Physicians in Jubail (figure 2).

The percentage of physicians who had "some or more Knowledge" of HBO<sub>2</sub> therapy in the treatment of chronic non-healing wounds among physicians was relatively high (76.2%) reflecting that the first step in the process of diffusion of new technology/innovation has already started among the Physicians in the Saudi Armed Forces Hospitals (figure 3 and table 2).

Knowledge was also significantly associated with physicians' dependence on various sources of information to stay informed about the evidence of wound care treatment. Scientific Medical Journals (table 3). Clinical Guidelines (table 4). The Internet Base of Continuing Medical Education, Peers, Traditional Continuing Medical Education (Table 5). Knowledge in addition turned out to be significantly associated with

patient's voluntary request of HBO<sub>2</sub> therapy (table 6) in the multiple linear regression analysis. This is a very important and significant point to concentrate on for better use of HBO<sub>2</sub> therapy in the future.

Physician's Attitude towards HBO<sub>2</sub> therapy was significantly associated with their Knowledge (figure 4, table 7). Physicians agreed with the use of HBO<sub>2</sub> therapy for the treatment of chronic non-healing wounds when Physicians had "some or more Knowledge" (66.7%) compared to none or little Knowledge" (43.5%).

The multiple linear regression analysis (table 8) also showed this strong association which emphasised the theme that Persuasion/Attitude is strongly dependent on Knowledge in the diffusion of innovation model.

Physician's Attitude towards HBO<sub>2</sub> therapy was significantly associated with Hospital Location (figure 5, table 9). The highest was in Jubail (80%) where HBO<sub>2</sub>

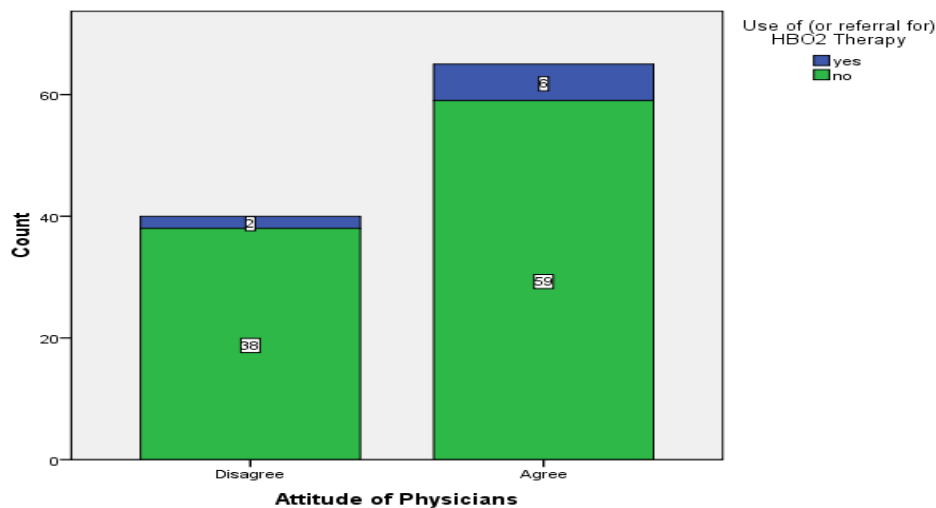
**Table 5.** Physicians Knowledge of HBO<sub>2</sub> therapy in the treatment of chronic non-healing wounds as a function of Internet Base of Continuing Medical Education (as a source of information), n=110.

Internet Base Continuing Medical Education	Knowledge of Physicians		
	None or little knowledge	Some or more Knowledge	Total
Never	5(65.5)	3(37.5)	8(100.0)
Rarely	5(38.5)	8(61.5)	13(100.0)
Occasionally	1(4.3)	22(95.7)	23(100.0)
Fairly Often	12(30.0)	28(70.0)	40(100.0)
Very Often	2(9.1)	20(90.9)	22(100.0)
Total	25(23.6)	81(76.4)	106(100.0)

Chi-sq = 16.519      df = 4      P = 0.002

**Table 6.** Linear Regression Analysis: Effect of the independent variables on Physicians Knowledge of HBO<sub>2</sub> therapy in the treatment of chronic non-healing wounds (n=110).

Independent Variable	Practice of HBO <sub>2</sub> therapy		
	Coefficient B	P	95% C. I. of B
(Constant)	8.244	0.00	5.142 – 11.345
Patient's request of HBO <sub>2</sub> Therapy	1.761	0.002	0.686 – 2.837
Clinical Guideline	0.742	0.244	- 0.514 – 1.999
Internet base Medical Education.	- 0.405	0.504	- 1.603 – 0.794
Scientific Medical Journals.	0.981	0.137	- 0.319 – 2.281
Major Medical Specialty	0.207	0.305	- 0.192 – 0.605



**Figure 4.** Physicians (users and non-users, participated in the study). Attitude towards HBO<sub>2</sub> therapy in the treatment of chronic non-healing wounds.

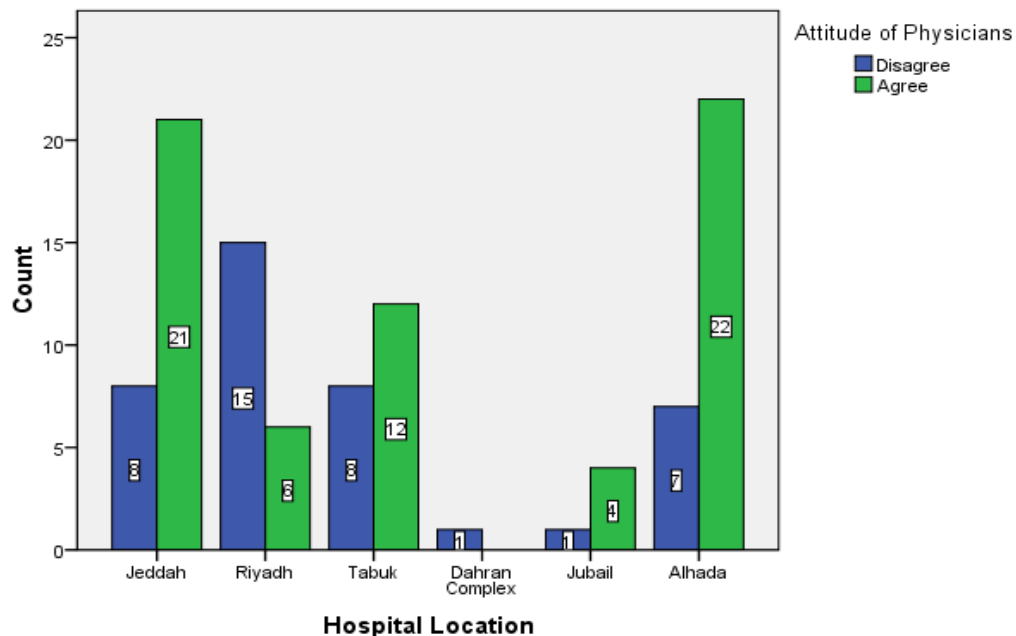
**Table 7.** Physicians Attitude towards HBO<sub>2</sub> therapy in the treatment of chronic non-healing wounds as a function of Knowledge (n=110).

Knowledge of HBO <sub>2</sub> Therapy	Attitude of Physicians		
	Disagree	Agree	Total
None or little knowledge	13 (56.5)	10 (43.5)	23 (100.0)
Some or more Knowledge	26 (33.3)	52 (66.7)	78(100.0)
Total	39(38.6)	62(61.4)	101(100.0)

Chi-sq = 4.029      df = 1      P = 0.04

**Table 8.** Linear Regression Analysis: Effect of the independent variables on Physicians Attitude towards HBO<sub>2</sub> therapy in the treatment of chronic non-healing wounds (n=110).

Independent Variable	Practice of HBO <sub>2</sub> therapy		
	Coefficient B	P	95% C. I. of B
(Constant)	14.269	0.00	10.188 - 18.349
Age	0.655	0.487	- 1.208 - 2.519
Years of practicing	0.035	0.935	- 0.826 - 0.896
Qualification	0.191	0.547	0.436 - 0.818-
Location	0.996 -	0.154	- 2.371 - 0.379
Knowledge	0.338	0.002	0.127 - 0.549



**Figure 5.** Physicians Attitude towards HBO<sub>2</sub> therapy in the treatment of chronic non-healing wounds as a function of Hospital Location, n=110.

**Table 9.** Physicians Attitude of HBO<sub>2</sub> therapy in the treatment of Chronic non-healing wounds as a function of Hospital Location (n=110).

Hospital Location	Attitude of Physicians		
	Disagree	Agree	Total
Jeddah	8(27.6)	21(72.4)	26 (100.0)
Riyadh	15(71.4)	6(28.6)	21(100.0)
Tabuk 16-20yrs	8(40.0)	12(60.0)	20(100.0)
Dhahran.Cmplx	1(100.)	190(0.0)	1(100.0)
Jubail	1(20.0)	4(80.0)	5(100.0)
Alhada	7(24.1)	22(75.9)	29(100.0)
Total	40(38.1)	65(61.9)	105(100.0)

Chi-sq = 1.998      df = 5      P = 0.007

**Table 10.** Physicians Attitude towards HBO<sub>2</sub> therapy in the treatment of chronic non-healing wounds as a function of years of Medical Practice (n=110)

Medical Practice (years)	Attitude of Physicians		
	Disagree	Agree	Total
<6 yrs	17 (65.4)	9 (34.6)	26 (100.0)
6-10 yrs	9 (39.1)	14 (60.9)	23(100.0)
11-15 yrs	0(0.0)	6 (100.0)	6(100.0)
16-20yrs	3(13.6)	19(86.4)	22(100.0)
21-25 yrs	9(52.9)	8(52.9)	17(100.0)
26-30 yrs	1(16.7)	1(16.7)	6(100.0)
>30 yrs	0(0.0)	0(0.0)	2(100.0)
Total	39(38.2)	39(38.2)	102(100.0)

**Table 11.** Physicians Attitude towards HBO<sub>2</sub> therapy in the treatment of chronic non-healing wounds as a function of Qualification other than MBBS (n=110).

Qualification other than MBBS	Attitude of Physicians		
	Disagree	Agree	Total
Training Courses	13 (65.0)	7(35.0)	20 (100.0)
Diploma	4 (44.4)	5 (55.6)	9(100.0)
Masters	3(33.3)	6 (66.7)	9(100.0)
PhD	1(9.1)	10(90.9)	11(100.0)
Board Fellowship	13(30.1)	30(69.8)	43(100.0)
Registrar	2(100.0)	0(0.0)	2(100.0)
Other	3(37.5)	5(62.5)	8(100.0)
Total	39(38.2)	63(61.8)	102(100.0)

Chi-sq = 14.66      df = 6      P= 0.023

**Table 12.** Physicians practice of HBO<sub>2</sub> therapy in the treatment of chronic non-healing wounds as a function of major medical speciality (n=110).

Major Medical Specialty	Practice of HBO <sub>2</sub> therapy		
	Yes	No	Total
Diving and Hyperbaric Medicine	4(100.0)	0.0	4 (100.0)
general Surgery	1(2.7)	36(97.3)	37(100.0)
Plastic Surgery	0(0.0)	4(100.0)	4(100.0)
Vascular Surgery	1(14.3)	6(85.7)	7(100.0)
Family Medicine	1(2.5)	39(97.5)	40(100.0)
Home Health Care	0(0.0)	6(100.0)	6(100.0)
Other	1(9.1)	10(90.9)	11(100.0)
Total	8(7.3)	101(92.7)	109(100.0)

Chi-sq = 54.386      df = 6      P= 0.000

**Table 13.** Physicians Practice of HBO<sub>2</sub> therapy in the treatment of Chronic non-healing wounds as a function of Hospital Location (n=110).

Hospital Location	Practice of HBO <sub>2</sub> therapy		
	Yes	No	Total
Jeddah	1(3.2)	30(69.8)	13 (100.0)
Riyadh	0(0.0)	23(100.0)	23(100.0)
Tabuk	1(50.0)	19(95.0)	20(100.0)
DahranComplex	1(100.0)	0(0.0)	1(100.0)
Jubail	5(100.0)	0(0.0)	5(100.0)
Alhada	0(0.0)	30(100.0)	30(100.0)
Total	8(7.3)	102(92.7)	110(100.0)

Chi-sq = 14.611      df = 4      P = 0.006

therapy was practiced, followed by the western province of Saudi Arabia where HBO<sub>2</sub> chambers were present. Alhada (75.9%) and Jeddah (72.4%). Physicians Attitude towards HBO<sub>2</sub> therapy was also significantly associated with more number of years of Medical Practice (table 10), higher qualifications like PhD and Board certifications (table 11). This may be owed to physicians with higher qualifications, had more experience and developed more Knowledge of and better attitude towards HBO<sub>2</sub> therapy. Board certified physicians tend to adopt more new procedures than physicians who are not Board certified (Freiman, 1985).

Physician's practice of HBO<sub>2</sub> therapy was significantly associated with their Major Medical Specialty (table 12). Diving and Hyperbaric Medicine (100%), Plastic Surgery (100%) Family medicine (97.7%), General Surgery (97.5%). Physicians Practice was also significantly associated with Hospital Location (table 13). Jubail and Dahran complex is the highest (100%), followed by tabuk (50%) and Jeddah (3.2%) although the latter two cities have HBO<sub>2</sub> Chamber at their Facility Practice.

## CONCLUSIONS

HBO<sub>2</sub> therapy showed increasing evidence for its efficacy, effectiveness and more recently for its cost-benefit as an adjunctive treatment for chronic non-healing wounds especially for diabetic foot ulcers. Concomitantly this lead to the rising high Knowledge and Attitude of the Physicians for this treatment. In sharp contrast several factors culminated to the low level of Practice of HBO<sub>2</sub> therapy in the Saudi Armed Forces Hospitals, mainly the unavailability(except in Jubail) of the HBO<sub>2</sub> therapy (rather than the unavailability of HBO<sub>2</sub> Chambers) which

were relatively inaccessible (like the multiplace chambers in Jeddah and the newly built chamber in Tabuk).

## RECOMMENDATIONS

In order to make the inactive chambers functional, it is suggested to implement and disseminate a Protocol for use of (or referral of patients for) HBO<sub>2</sub> therapy. Also educating both Patients and Physicians (using effective communication channels like supporting related clinical symposia) and focusing on cost-effectiveness most probably will encourage future use of HBO<sub>2</sub> therapy.

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