

# SHL TeleMedicine: Applying the extensive Israeli experience globally

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SHL TeleMedicine, a company which develops and provides telemedicine services, was founded in 1987 in Israel by private investors. It has now grown to become a large international operator of telemedicine services and a publicly traded company quoted in the SWX stock exchange in Zurich. Currently serving more than 60,000 subscribers in Israel, SHL is the clear market leader at home, and is establishing a significant presence across Europe and North America. The company's success in international expansion is based on a clear strategy of replicating its successful medical call center business model which produced SHL's unique brand of accurate and reliable high-quality telemedicine services that are provided to its subscribers who use technologically advanced user-friendly devices. The determination to put state-of-the-art technology to work in meeting basic human needs, saving lives, and improving quality of life – even for those who live under the constant threat of heart failure – remains pivotal to SHL's development as a company. A comprehensive on-going research program is essential to this scheme, both for refining and improving products and services that are already being offered, and for identifying new healthcare areas in which telemedicine could make a real difference to people's lives.

## Operational Model

At the hub of SHL's operational model is a central medical call facility equipped with an advanced modular computer system, staffed and managed by experienced medical professionals trained to interpret electrocardiograms (ECGs) and other medical data transmitted to them via telephone by the service's subscribers. Although in many cases the caller's condition requires no more than medical advice or verbal assurance, the center's medical staff is empowered to dispatch mobile intensive care units should the situation demand such urgent action.

## Medical familiarity

All new SHL subscribers are personally interviewed by a physician, and their medical records (including a baseline 12-lead ECG) are stored and regularly updated in a central computer. Subscribers carry a CardioBeeper® which they can use to transmit over the telephone a 12-lead ECG to the medical call center. They are also supplied with an automatic LidoPen intra-muscular 300 mg lidocaine injector for self-injection when so instructed by the medical call center (Roth, 1997a). When subscribers call the medical call center and are identified by name or identification number, their medical file is immediately displayed on a computer screen. The medical call center nurse then obtains all the necessary information from their files and analyzes their transtelephonic anamnesis and real-time ECG before assessing the caller's state of health and before taking appropriate action. Depending on the nature of the patient's condition, the nurse will provide the patient with appropriate medical or behavioral instructions, or a mobile intensive care unit can be dispatched according to SHL's standard operating procedures. If necessary, the nurse may consult the medical call center's on-duty physician.

The nurse's actions and decisions are based upon written protocols established by senior cardiologists who comprise SHL's medical advisory council. Details of every call each subscriber makes, including timetables and the resultant action taken, are recorded and stored at the medical call center. Subscribers are repeatedly encouraged to contact SHL whenever new symptoms occur, regardless of their severity. Indeed, the company's first and foremost aim remains that of maintaining the highest levels of excellence in the services provided to its subscribers – people who have come to place their trust, and often their lives, in SHL's hands.

## Expanding the SHL-brand of peace of mind

This ethos, clear-cut and un-compromising, has shaped the company throughout its 15-year history. Having achieved home-market leadership – in Israel alone, the Tel Aviv medical call center processes more than 275,000 calls and 150,000 ECGs each year – SHL has embarked on an ambitious international expansion plan based on re-creating its successful medical call center model for use abroad. A series of successful strategic alliances opened the doors for SHL products.

The strong links with The Netherlands-based Royal Philips Electronics initiated during 2000 led to the establishment of an exciting new joint venture. Philips Telemedicine launched a major drive to offer personal telemedicine services throughout mainland Europe, opening three medical call centers, through which SHL-brand telemedicine products and services are already being marketed in Switzerland, Germany, and Italy. Philips Telemedicine intends to continue its European expansion.

Most recently, SHL acquired the US cardiovascular healthcare services provider Raytel Medical Corporation, a leading provider of remote pacemakers monitoring services in the US and supplier of other cardiac diagnostic services utilizing trans-telephonic monitoring technologies. The acquisition of Raytel's substantial client network now brings SHL technology and experience into the US market, offering new and existing subscribers in North America the benefit of an extended, fully-integrated range of high-quality telemedicine products and services. SHL's confidence in US-based telemedicine technology is deep-seated – the company's flagship products are approved by the Food and Drug Administration (FDA) and ready to be introduced into the U.S. market.

## Medical research – the key factor shaping SHL's business

SHL's success in its transition from a local to a global telemedicine provider is firmly rooted in the strength and scope of thorough and continuous research and development. The company's commitment to a sustained and wide-ranging study program remains firm, and has produced results that have helped SHL refine and direct its offering of products and services while being of interest to the industry as a whole.

In addition to keeping a watchful eye on emerging cutting-edge technology for possible applications in the system, SHL's self-examination is painstaking despite its considerable size. Using its ability to monitor a wide range of characteristics among the individual subscribers, SHL has been able to establish a medical database from which a vast amount of information can be retrieved and analyzed by experts using state-of-the-art computer systems. This wide range of detailed data has also provided the material for an appreciable number of presentations to national and international scientific conferences, as well as articles in peer-reviewed publications (references listed below). Additional lines of investigation are currently in progress.

In the first retrospective study carried out by SHL, it assessed the impact of the company and its services on subscribers' mental stress, self-confidence, and overall quality of life (Roth et al., 1993). Responses to a written questionnaire and personal interview were analyzed, and showed that subscription to SHL's telemedicine services effectively decreased mental stress and improved self-confidence for most respondents. Telemedicine was considered especially beneficial for women, the elderly, individuals of a lower socioeconomic status, pessimists and chronic worriers, and particularly so for those who were ill rather than healthy. Those whose functional capacities were very limited derived less benefit in terms of stress reduction: for them, SHL's function was more valuable as a life-saving and rescue system. Lastly, but not inconsequentially, subscription to SHL also improved the self-confidence of subscribers' families.

An ensuing study (Roth et al., 1995) assessed the impact of SHL on subscribers' "decision time". Data from 10,304 charts (69% cardiac patients, 15% completely healthy individuals) were reviewed and analyzed over a one-year period. The median decision time for the group as a whole was 44 minutes within a range of less than 15 minutes to more than three hours. More than half the subscribers (59%) called within an hour from the onset of symptoms, while 29% delayed calling for three hours or longer. The healthy subjects alerted the service significantly earlier, after 29 minutes.

Shortly thereafter, SHL was already serving more than 40,000 subscribers with cardiac, pulmonary and blood pressure conditions (Roth et al., 1997b); the percentage of the apparently healthy or those with only coronary risk factors and without evident disease was steadily increasing. About 150,000 calls were received per year, and fewer than 10% of the callers required transportation to a hospital for further evaluation.

#### **Constantly re-evaluating operating protocol**

One of the continuing self-examinations of SHL's operative protocol led to a report on the experience accumulated by the subscribers of the SHL telemedicine cardiac services who used a LidoPen automatic injector to self-inject intramuscular lidocaine for documented ventricular tachyarrhythmias not associated with an acute myocardial infarction (Roth, Malov, et al., 1997). Indications for self-injection were (1) the transmission of a wide-QRS tachycardia (a rate of >100 beats per minute), symptomatic multiple or complex ventricular premature complexes in association with chest discomfort, and when the time of arrival of a medical team to the patient was estimated to be at least eight to ten minutes. Successful use of the LidoPen was reported in 137 cases (123 patients) while 11 other patients failed to use the injector properly. Overall, a success rate of 33% was achieved (35 of 106 patients) in abolishing rapid sustained ventricular tachycardia (27 of 76 patients) and non-sustained ventricular tachycardia and/or multiple and complex ventricular ectopic activity (eight of 30 patients). Those arrhythmias were slowed markedly in another 9%. The remaining 31 cases were eventually interpreted as being of supraventricular origin. There were no reported complications attributed to the use of the injector, and its use was found to be both feasible and effective in the pre-hospital setting.

As part of SHL's commitment to constant improvement and refinement of its diagnostic tools, the CardioBeeper® CB-12L ECG transmission device was developed. In order to evaluate the accuracy and practicability of this new device, tracings from 20 subjects with various electrocardiographic pathologies were made and analyzed. Out of a total of 40 tracings, 20 standard ECG tracings were obtained under medical supervision in the physician's office, while the other half were carried out by the patient at home using the new device, then transmitted via telephone to SHL's telemedicine monitor center. The data recordings were reviewed by 19 experienced physicians who were asked to interpret the results and identify the source device of each recording. In 82% of cases, the interpretations of the tracings were identical for both modalities while an equal number of physicians could not identify the device with which individual tracings were made. Accurate placement of the electrodes proved not to be a problem for the patients. This study (Roth, Bloch, et al., 1997) established the CardioBeeper® CB-12L as a reliable and easy-to-operate tool for early and prompt diagnosis of threatening cardiac situations in a pre-hospital setting.

Last year, SHL launched a new ECG transmitter, the CardioBeeper® 12/12, a compact hand-held device facilitating the transmission of a full 12-lead ECG to the medical call center in 12 seconds.

More recently, research studies have shown that the validity of measurements recorded by SHL's TelePress™ are not distorted by the so-called "white-coat" effect (Roth et al., 1999). This was established by a study conducted on 30 SHL subscribers who transmitted their self-measured blood pressure values for analysis via the telephone. The ten non-hypertensive and 20 hypertensive subscribers performed two random sets of blood pressure measurements over ten consecutive days, each consisting of three consecutive measurements. In one set, patients' results were automatically transmitted to the monitor center, while patients in the other set recorded but did not transmit their results. No difference was observed between the mean transmitted and the mean non-transmitted blood pressures – each measured  $87 \pm 10$  mm Hg. This program was further validated by the popularity of the TelePress™ among existing subscribers: the monthly average of self-measured blood pressure recordings for the entire SHL subscriber population was 1.8 transmissions, while 25% of patients with a cardiac history used the TelePress™ up to five times a month.

#### **Facing the diagnostic challenges**

Among the greatest challenges facing modern medicine are the parallel issues of increasing diagnostic accuracy and reducing the likelihood of missed diagnosis –especially in fields where a speedy diagnosis can have a critical impact on survival. This is certainly the case with myocardial infarction. In a two-part program, we studied an innovative concept, a qualitative rapid bedside immunoassay device for the detection of elevated creatine kinase MBmass (CK-MB) and myoglobin (stage 1; Roth, Carthy, et al., 1999), and considered its usefulness as a supportive decision-making tool for a physician evaluating patients with chest pain. This prospective study on 328 patients in the pre-hospital phase found that if the device was used between two and 12 hours after the onset of symptoms it performed well as a convenient diagnostic aid for preventing the misdiagnosis of acute myocardial infarction and helped avoid unnecessary investigative hospitalization. In the program's second phase (Roth et al., 2001), we assessed the value of cardiac markers in ruling out acute ischemic events in patients with symptoms of possible cardiac origin and with non-diagnostic ECGs. Relevant information was prospectively retrieved from the records of 777 pre-hospital patients whose symptoms had lasted between six and 48 hours. Each patient had been treated by mobile intensive care teams and in each case the physician was unable to reach a clear-cut decision as to whether the patient should be taken to hospital or left at home. CK-MB, myoglobin, and troponin I were measured at the scene using a rapid Stat kit to detect their presence qualitatively in whole blood samples. Results were determined after 15 minutes at the scene. Positive and negative predictive values of the assay for detecting a significant coronary event were 36.7% and 100%, respectively. Of the 747 patients with a negative result, the result was false in six cases (one with myocardial infarction and five with unstable angina), representing a 99.2% negative predictive value. We concluded that measuring cardiac markers in the pre-hospital setting was useful in ruling out high-risk coronary syndromes when the clinical presentation and ECG are inconclusive, and that this tool may be a promising cost-cutting factor in these days of escalating expenses and dwindling resources. In line with its commitments to rapidly adopt advantageous advancements such as these, SHL is now incorporating these findings into its list of services and standard operating procedures.

#### **Membership Reduces Costs**

All contemporary healthcare givers are faced with the relentless and ever-increasing pressure to cut costs, and SHL TeleMedicine is no exception. SHL has also considered whether telemedicine subscriptions may have beneficial macroeconomic effects stemming from patient decision-making, particularly in terms of favorable repercussions on national health costs (Roth, Malov, et al., 2000). During a six-month period a random group of subscribers who had called for medical assistance during the previous 24 hours were asked what action they would have taken had they not been subscribers. All 1,608 study patients were followed for at least seven days: 514 replied that they would have waited, 363 would have contacted their physicians, and 731 would have sought hospital emergency department care. Given the benefit of being able to call on SHL's telemedicine services for triage and assistance, 86% of the presenting medical problems were resolved without utilizing hospital facilities. Cost-saving estimates based on these results indicated that SHL's services save the national economy approximately \$830,000 per 10,000 members per year. These results demonstrate the extent to which an SHL membership reduces the costs of medical care and the number of hospital emergency department visits.

#### **Databanks put to valuable use**

With SHL's valuable treasury of monitor center data at our disposal, it has been able to look at some epidemiological aspects of cardiovascular disease which are of practical interest for the medical community in general, in terms of planning treatment (Viskin et al., 1999). Based on the findings of a near 10,000-patient cohort, the research showed that the onset of paroxysmal atrial fibrillation has a circadian pattern featuring a clustering of events in the morning and, to a lesser degree, late in the evening. A prominence of weekly and yearly circadian patterns also emerged from our findings.

In addition, SHL has evaluated the impact of selected common risk factors for cardiac death on the success of out-of-hospital cardiopulmonary resuscitation (CPR) (Roth, Golovner, et al., 2000). From among the various parameters measured in 998 patients, a history of hypercholesterolemia emerged unexpectedly and inexplicably as a factor that adversely affects the outcome of CPR to a significant degree. This would suggest that hypercholesterolemia deserves special consideration and aggressive treatment in this patient population.

SHL's latest project has involved an assessment of the effect of the SHL program on patients' admission rate and length of hospital stay, as well as changes in their quality of life as subjectively rated by patients with chronic heart failure (unpublished data). SHL was shown to provide good at-home primary care while simultaneously noticeably reducing both hospitalization rate and length of stay and significantly enhancing our subscribers' quality of life.

#### **Research - the driving force behind product development**

Drawing together valuable information from in-house studies helps further SHL's determination to constantly review products and services to ensure that they utilize the most advanced technologies while meeting highest possible quality standards. The newest SHL products, an updated version of the TelePulse Oximeter and a new SHL blood measurement device due for release by the end of this year, are the direct results of the company's research and development program. Similarly, SHL's product pipeline includes two exciting new products scheduled for launching next year: a congestive heart failure pre-deterioration algorithm and a technologically advanced innovative ECG monitoring product.

Furthered by extensive research resources, long-standing experience in providing telemedicine, and high-level technological expertise, SHL TeleMedicine will continue to run its international business with the clear focus that has distinguished the company for the past 15 years. It remains committed to use investigative research to cut through the boundaries of traditional healthcare provision – enhancing subscribers' quality of life, offering real peace of mind and, wherever possible, saving lives.

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