Telemedicine and related technologies in South Korea

Report of a DTI-supported overseas mission to South Korea in March 2001

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Executive summary

The mission was sponsored by the University of Portsmouth, home of the UK National Database of Telemedicine and co-host of the UK Telemedicine Information Service. The aim of the mission was to explore opportunities for co-operation between UK and Korean organisations in the field of telemedicine and related health informatics areas. Our primary aim was to find out what they are doing, but equally to let them know what is going on in the UK. The mission visited Seoul in South Korea between 5th and 9th March 2001. We made 14 visits to organisations, and met some of the leaders of the medical informatics community and some political policy makers in the health sector.

South Korea does a large amount of trade with the USA and Japan, but is looking to increase its relationships with China, Southeast Asia (including Malaysia) and Europe. The UK is Korea's 10th biggest trading partner, with the balance of trade being firmly on the Korean side. However Koreans like and respect the British and remain grateful for the UK's commitment during the Korean War. Rapprochement with North Korea has started after a long period of zero contact. That may lead to some new challenges and opportunities for the South.

The technical infrastructure in Korea is excellent. 50% of the population have Internet access, ISDN lines are virtually universal and South Korea is the fastest growing market in the world for broadband access.

The Korean health sector has many interesting features. Korea spends a lower proportion of GDP on healthcare than the UK. 98% of the populace are members of a national insurance scheme that pays the cost of many healthcare services. Most hospitals are private, and organised into groups, often centred on a teaching hospital in Seoul. It is not unusual for an individual to visit several doctors to seek multiple opinions on his/her condition – in some cases we were told possibly as many as 10-15. As a consequence, it often happens that a patient is subjected to the same test or investigation many times over. The healthcare sector in Korea is very enthusiastic about IT solutions. However, like other service industries, the healthcare industry in Korea has always been relatively underdeveloped, and therefore could benefit from UK expertise on topics such as service delivery.

Telemedicine in Korea is generally of the "real-time" type, with most consisting of a videoconferencing link between doctor and patient. We saw or heard of examples where it is used to link patients at remote sites to regional centres, or to specialists at hospitals in Seoul. A project to provide telecare support to the housebound and mentally ill is underway.

Much effort has been put into the development and installation of hospital information systems to manage patient records and radiology images. We saw a number of these in operation, some of Korean manufacture, some from overseas. Because of the prevalence of patients seeking multiple medical opinions, much work is going into enabling the sharing of patient information.

Our impressions of the political and economic environment were generally positive. South Korea is a country with a phenomenal success rate for economic expansion. It has a successful IT sector that is leading the way in the sort of economic reforms that are necessary for the long-term growth to be sustained. Although the political and governmental systems do not work precisely like our own, it is possible to make things happen there.

There are a number of reasons why telemedicine offers good business opportunities in Korea:

- Patients' desires for multiple diagnoses.
- Patients' increasing desire to seek diagnoses from centres of excellence rather than their nearest doctor.
- The need to link rural areas to specialist centres in the big cities.
- The difficulties in moving around the big cities.
- The government's intention to remove the legal barriers to the use of telemedicine.

As the result of our mission, we make the following recommendations:

1. Steps should be taken to encourage contacts between the UK and Korean health sectors. We recommend that key players in Korean healthcare be identified and invited to the UK to see how we do things.

2. We did not see first-hand any examples of telecare in Korea. This may provide an untapped market for UK expertise and we recommend a follow-up visit by a small group to explore that in more detail.

3. We were not able to find out as much as we would have liked to about the use of smart cards in Korea. This may be a topic for a future mission to explore.

4. It is unlikely that in the short term any British company would be able to break into the Korean market for hospital information systems, PACS systems or basic videoconferencing – the Korean market for these is relatively well established. Better opportunities may exist in other Asian countries.

5. However, Korea does have the technical infrastructure in place that is necessary to underpin a wide variety of service-driven activities. We believe that in the areas of education, consultancy and the provision of service-supporting IT systems, Korea has much to learn from UK companies. Support should be provided, perhaps in the form of a trade mission, for the development of further contacts in this field.

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Preface

Throughout this report, we adopt the convention for Korean people's names that their family name is given first, followed by their given names. We apologise if we inadvertently get this wrong.

When referring to "Korea", except where otherwise explicitly stated, we are referring to South Korea, the country officially known as the Republic of Korea.

At the time of the mission, the exchange rate between the British pound (£) and Korean Won (W) was approximately W1800 = £1. However, in expressing approximate sums of money, a rough exchange rate of W2000 = £1 has been used for convenience.

Acknowledgements

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- The British Embassy in Seoul, in particular the Ambassador, Charles Humfrey, the then First Secretary for Science and Technology and Environment, Michael Cherrett, and the Commercial Officer, Mrs Chay Kye-Jin. Mike Cherrett did much to instigate the mission, while Mrs Chay proved an efficient organiser of our visits to companies and hospitals.
- All the companies and organisations we visited during our stay and all the people we met.

1   Introduction

1.1   Background to international missions supported by the DTI

The International Technology Service of the UK Department of Trade and Industry (DTI) provides financial assistance to small groups of experts from British industry to travel abroad on fact-finding missions[1]. The missions aim to improve the competitiveness of UK industry by making it more aware of developments in best practice and technology in other countries. The missions are sponsored by approved expert representative bodies. In this case, the National Database of Telemedicine/Telemedicine Information Service[2] at the University of Portsmouth was approached with a view to establishing a mission to see what's going on in telemedicine/medical informatics in South Korea.

Korea is one of the tiger economies of Asia and is already one of the world's leading industrialised nations. It is a country that most people in the UK know little about, and possibly dismiss as being secondary to the likes of Japan, China and Singapore. It is thus likely that UK industry is missing opportunities there.

Currently Koreans are looking for solutions to problems – many of them the same as ours. For example, they are concerned about how to pay for the spiralling demands for healthcare by the elderly in a country where life expectancy is rising and people can see that the technology is available to provide them with a better quality of life, if they can afford it.

1.2   The aims of the mission

Telemedicine is the use of information and communications technology (ICT) to support and deliver healthcare at a distance. It can be used to link together two or more healthcare professionals and/or their patients so that they can exchange information for the purposes of diagnosis, treatment or education. Its importance as a means for delivering healthcare services has been recognised in recent policy statements, including the NHS's information strategy. However, like other new developments, its introduction needs careful management.

This mission sought to explore opportunities for co-operation between UK and Korean organisations in the field of telemedicine and related health informatics areas. Our primary aim was to find out what they are doing, but equally to let them know what is going on in the UK.

The field of telemedicine is a broad one[3]. We established the following as being the areas most of interest:

- Applications of telemedicine, especially for the provision of more cost-effective means of delivering healthcare services, and for services that directly benefit the patient.
- Applications of telemedicine to NHS priority areas such as the care of the elderly (including telecare[4] services), etc.

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[1] http://www.dti.gov.uk/mbp/its/its.html

[2] http://www.tis.bl.uk

[3] For the purposes of this mission, we won't try to draw any significant distinctions between what different people refer to as telemedicine, telehealth, e-health, etc.

[4] Telecare is defined to be the use of information and communication technology to give patients (with or without their healthcare professional or informal carer) access to information sources wherever they are located. The telecare process frequently takes place within patients' place of residence.

- New information and communication technologies that are being or could be applied to telemedicine. This includes but is not limited to video conferencing, smart cards, mobile computing, Internet access to information and services, data capture devices and security and confidentiality related mechanisms. The integration of different technologies was also of interest.
- Other areas of health informatics that are most closely linked to telemedicine. This includes medical record keeping (electronic patient records, integrated care pathways, etc.), health information services (patient and/or professional access to health advice, guidance, evidence, etc.) and medical imaging (in all its forms).

1.3 Mission format and members

The mission visited Seoul in South Korea between 5th and 9th March 2001. After a briefing at the British Embassy, our visit started with a lunch hosted by the board of the Korean Society of Medical Informatics. The mission ended with a "round table meeting" over lunch at the National Assembly Building, hosted by senior policy makers from the ruling Millennium Democratic Party. In between, we made visits to six hospitals, a government-run institute, and several companies active in the health informatics field. Some of the visits were linked: for example, we visited Mediface's installation at Soon Chun Hyang Hospital rather than their company's headquarters.

The organisations we visited were:

Asan Medical Centre
BIT Computer
Korea Health Industry Development Institute
Macrogen
MD Saver
Medidas
Mediface
Samsung Medical Centre
Samsung SDS
Seoul National University Graduate School of Public Health
Seoul National University Hospital
Soon Chun Hyang Hospital, Bucheon
WorldCare Korea
Yonsei University Hospital, Graduate School of Health
Youngdong Severence Hospital

In addition to the visits we made, we delivered a seminar on telemedicine at the British Embassy. It gave the mission members an opportunity to talk about their organisations, and their view of how healthcare in general and telemedicine in particular would develop in the future. Approximately 80 people attended this; making it one of the most popular such seminars the Embassy had ever run. We repeated the seminar on a smaller scale later in the week to an audience of senior staff at the Asan Medical Centre.

The full list of mission members was:

Dr Neil Bindemann	Commercial Strategy Director
	Healthcare Education Services Ltd, St Albans
Dr Jim Briggs (mission leader)	Principal Lecturer in Information Systems
	University of Portsmouth, Portsmouth

Dr John Erbetta	Project Manager
	Defence Evaluation and Research Agency, Malvern
Mr Michael McCurry	Health Market Development Manager
	ACI Commerce, Camberley
Miss Toral Patel	Senior Consultant
	CLERT: The Centre for Law Ethics and Risk in Telemedicine, Cardiff
Dr Ricky Richardson	Consultant Physician
	The Great Ormond Street Hospital for Children, London and Richardson Consulting Ltd

In addition, we were accompanied by Hong Hai Seeto, the International Technology Promoter for Korea working for the DTI, and Mrs Chay Kye-Jin, one of the commercial staff at the British Embassy in Seoul who acted as guide and occasional interpreter.

With one or two exceptions, everyone we met spoke very good English and this facilitated extremely informative and often lively discussions.

1.4   Structure of the report

In this report, we describe the findings of our mission under three main headings:

- the socio-political environment for telemedicine in Korea (section 2)
- existing telemedicine systems in use in Korea (section 3)
- other clinical information systems, including hospital information systems (HIS) and picture archiving and capture systems (PACS) (section 4)

A further section (section 5) describes two other organisations we visited.

The report finishes with the conclusions we drew from our observations, and our recommendations for future action.

2   The socio-political environment for telemedicine

2.1   Economic background

Korea's development from a poor country (income per capita was about £60 in 1962) to one of the world's top industrialised nations has been a rapid one. Success was originally based on industries such as shipbuilding, automobiles, textiles and steel, and a dominant focus on exports. More recently, Korea has established an international reputation in sectors such as semiconductors and electronic products.

The economy has for the last 50 years been dominated by the *chaebol* – large family run conglomerates that believe "big is best" and who traditionally prioritise greater turnover and market share over profits. Th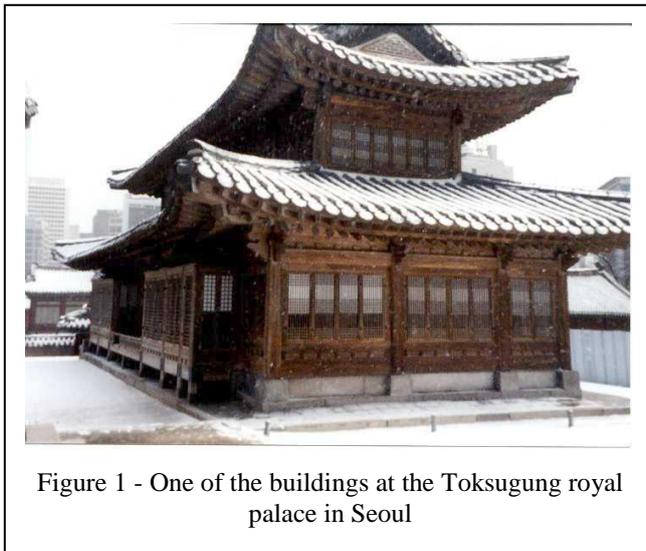e five largest chaebol are Hyundai, Samsung, LG, Daewoo and SK. The top 30 companies account for 70% of GDP, and the top 10 account for 50% of exports. In recent years, the chaebol have met trouble in meeting their debts. Many short-term borrowings, particularly in foreign currency, have become hard to service, as revenue has dipped as a result of the slowdown that has affected most Asian economies. Some are technically insolvent, but the government is unwilling to see the biggest go out of business and have instituted rescue packages in return for commitments to restructuring and concentration on fewer sectors of business.

Figure 1 - One of the buildings at the Toksugung royal palace in Seoul

The Korean development model is characterised by high growth rates, a reliance on short-term loans even for long projects, and the maximum government debt is only 5 years. Therefore, there is a low public debt ratio.

Some basic facts and figures about South Korea and its economy:

- The population was 47.2m in 2000.
- At the end of January 2001, foreign exchange reserves totalled £66.8b with GDP per capita in 1999 at £6070.
- GDP growth rate was 9.2% in 2000 and the official government forecast for 2001 is between 5 and 6%.
- Inflation stands at 4.2% and the unemployment rate is 4.1%.

The Korean economy has fundamental strengths. It is the world's 13th largest economy. There is a commitment to education. It has good infrastructure. There is a pervasive culture of work and ambition. It has world-class industries and a dynamic SME sector. Spending on research and development is high. It is an emerging new economy. It has a high Internet penetration rate.

However, there are many challenges still to face. Corporate restructuring still has far to go. There needs to be more transparency and higher standards of corporate governance. The capital markets are developing, but slowly and there is a distinct lack of long-term capital. Privatisation of public sector institutions is fragmentary. There are labour issues to resolve

regarding a mobile labour force and the decline in "jobs for life" that were traditional for those working for the chaebols. There is an ambivalent attitude to foreign investment. There is still much government micro-management of the economy.

The economy is susceptible to outside forces – 60% of GDP is foreign trade, either imports or exports. Much of Korea's short-term fortunes depend on how the US and Japanese economies cope with their domestic economic issues. The reduction in exports of ICT products has significantly affected Korea. There are also fears of an increase in unemployment that may lead to a further slowdown in consumption and initiate a "vicious circle" effect on demand.

At the time of the mission's visit, Korea was continuing its rebound from the Asian financial crisis of 1997. Although official predictions of growth in the economy exceeded those of financial observers, the general feeling is that Korea will "muddle through" and continue on its goal to be one the top 10 industrialised countries.

2.2   Research and development

Korean investment in research and development (R&D) is high – much higher than in the UK. Korea spends around 3% of GDP and aims to increase that to 4% by 2005. 80% of R&D funding is from industry and 20% from government. The largest government contributions are from the Ministry of Industry and from the Presidential Office, which controls the Government Research Institutes. Even during the worst phases of the economic crisis, the government rigidly defended R&D spending as a means of digging their country out of its hole. Who could imagine a British government doing the same during a time of recession? R&D spending is concentrated on all things IT, electronics and semiconductors, but also on biotechnology, genomics, new cancer drugs and satellite technology. Other sectors (e.g. automobiles) have lots of ambition but less clear forward goals.

As an illustration of the effect of this sort of investment, R&D budgets in some sections of Samsung and LG went up by as much as 40% in 2000. While Korea believes strongly in using policy to give a fillip to industry, there are instances where Korean organisations are cash rich but idea poor, thus providing opportunities for British companies.

2.3   The political environment

South Korea's head of state is President Kim Dae-Jung, elected to office in 1997 for a single five-year term. The presidential system is strong, with the main power concentrated in the Blue House – the presidential office. The legislature is a unicameral National Assembly with 299 members elected to four-year terms. It can delay or prevent legislation, but it is rare for major measures to originate there. Brawls, boycotts and brinkmanship are frequent features of its business.

The president appoints the prime minister and through him the cabinet and other ministers. An unusual aspect of the Korean system is that ministers are rarely members of the National Assembly and are certainly not all career politicians. Ministers are often appointed from among senior executives of companies. Reshuffles are frequent – it is unusual for a minister to hold a post for more than two years.

President Kim leads the Millennium Democratic Party (MDP), which, in coalition with the United Liberal Democrats (ULD), also holds power in the National Assembly. The largest single party, and the official opposition, is the Grand National Party (GNP), led by Yi Hoe-Chang. Another interesting feature of Korean politics is the frequent reformation and renaming of political parties. Party affiliations are often based on regional ties – for example, the MDP has its centres of support in Seoul and in the southwest of the country. The GNP is strong in the southeast, around Pusan.

President Kim has had much popular support, particularly for his initiatives to reunite the two Koreas (see section 2.5 below), however recent difficulties including the economic situation have resulted in a loss of popularity. His domestic approval rating has dropped from over 60% when first elected to only 30% in a recent survey. It is by no means certain that his party will retain the presidency after the 2002 elections, and there may even be a major political realignment between now and then as the candidates for his post jockey for advantage.

All walks of life in Korea are affected directly or indirectly by government direction. Many sectors of the economy are "micro-managed" in a way that would seem inappropriate in the west. This means that gaining government support (moral and political support as well as financial) is an essential ingredient in most development projects. Korean companies will undertake quite sophisticated steps to attract the attention of ministers and senior civil servants, in order to be able to make their pitch for support.

2.4   International relations

South Korea has its closest international ties with the USA and Japan.

The former relationship is a result of the long-standing alliance that has lasted since US forces liberated the southern part of the Korean peninsular from Japanese rule in 1945. The US was predominant in the UN force that repulsed the invasion by the North (supported by China) in 1950 and that led to the Korean War that lasted until 1953. American forces have been based in South Korea ever since and their influence has been heavy on all aspects of life. Many Koreans speak English with an American accent. Many of the Koreans we met during our visit had studied at universities in the USA. While Korea retains very many aspects of oriental culture, those aspects of western culture that it has assimilated have been largely American in origin. The US also accounts for 17% of Korea's exports and 22% of its imports.

The relationship with Japan is based on physical proximity. Mainland Japan is only 100 miles or so off the southeast coast of Korea. However, the relationship has not always been cordial. Japan effectively annexed Korea and ruled it harshly from 1910-1945. Attempts were made to impose Japanese language and culture in place of Korean. Many older Koreans remember that time with bitterness. The modern relationship is founded on trade – 9% of Korea's exports and 18% of its imports cross the Korea Strait – and the common interests that these northeast Asian nations have when dealing with the rest of the world.

A growing trade partner is China. The trade across the Yellow Sea forms 9% of Korean exports (a further 7% go to Hong Kong) and 7% of its imports. The size of the potential market makes China very attractive and there will be great opportunities in the future, but the pace at which the Chinese market is opening up is very slow.

Korea is keen to reduce its dependence on the USA and Japan for trade. One of the places it is looking to replace them is the EU. While Germany has the edge at the moment in quantity of trade, Britain has an advantage because so many Koreans speak our language – even if they did learn it from our American cousins!

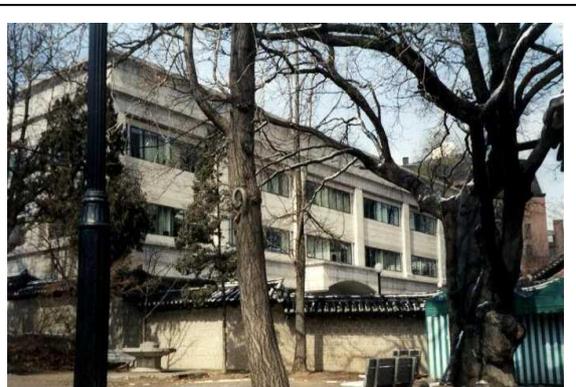The UK is Korea's 10th biggest trading partner, with the balance of trade being

Figure 2 - The British Embassy in Seoul

firmly on the Korean side. However Koreans like and respect the British and remain grateful for the UK's commitment during the Korean War. In recent years, the bilateral relationship has increased with regular meetings between Korean presidents and British prime ministers, and frequent visits by British ministers to Seoul. The Queen and Duke of Edinburgh visited Korea for the first time in 1999 – a visit that reinforced the strong ties between the two nations.

2.5   Consequences of improved relations with North Korea

Relations between the two Koreas took a surprise turn for the better in 2000. After over 50 years of total separation (bearing in mind that no peace treaty has ever formally ended the Korean war), the two "Kims", President Kim Dae-Jung of the South and President Kim Jong-Il of the North met in a historic summit in June. The result was a vague but well-intentioned agreement to foster closer ties, including ministerial meetings, family reunions, and the rebuilding of a railway link across the demilitarised zone that separates the two countries. It is expected that closer co-operation will result in the South offering financial support to the hungry and impoverished North.

The UK is going through the processes of establishing diplomatic relations with the North. Affairs are currently administered through the Seoul embassy, but there are plans to establish a resident mission in P'yongyang (the capital city) in the near future. There is very little information available on the opportunities and barriers for trade with the North. Some British companies are already active there and more will follow, but it is currently a risky proposition. The Seoul embassy is willing to share advice with those contemplating stepping into that country.

2.6   The technical infrastructure

As one would expect of a developed country, the technical infrastructure necessary to underpin information and communication technologies is virtually universally in place.

The telephone system is good and reliable with one phone for every two members of the population (a similar ratio to the UK). Virtually all parts of Korea have access to ISDN lines. About 25% of Korea already has access to ADSL lines and this is the fastest growing broadband access market in the world. Korea Telecom, which only entered the broadband market in mid-2000, already has a market share of 64%. Cable Internet connections are also popular.

Mobile phone usage is not quite at UK levels (yet), but we did notice that almost everyone we met in Seoul carried one.

Spending on IT has already reaped rewards. Korea has the tenth largest number of Internet users in the world. A target of 50% of Koreans being on the Internet by 2005 has already been reached – a new target of 95% has been set. There is a big expansion of access points in schools and public places (e.g. post offices), and network speeds are increasing by factors of 1000 or more.

2.7   The Korean healthcare system

In terms of spending on healthcare, Korea ranks much lower than the UK. Whereas the UK spends something like 8% of GDP on health, Korea probably only spends 3-5%.

The vast majority (98%+) of the population are members of the National Insurance system. This pays healthcare providers a set fee for the provision of approved services. It does not cover many new types of investigation – for example, many of the newer scanning technologies such as CT are not covered by the scheme.

There are few public hospitals. 95% of hospitals are private, often organised in groups centred on one of the big university teaching hospitals in Seoul. We visited a number of these – descriptions of what we saw can be found in section 4. The country boasts 850 hospitals, 19,000 clinics (defined as a small hospital with less than 50 beds) and 18,000 pharmacies. The total number of doctors in South Korea is approximately 60,000. An estimated 450m prescriptions are written per year.

There are 20-30 major pharmaceutical companies operating in Korea, with about 180 smaller ones. This includes many of the major multi-nationals.

There is an unusual pattern of demand for healthcare in Korea. It is not unusual for an individual to visit several doctors to seek multiple opinions on his/her condition – in some cases we were told possibly as many as 10-15. As a consequence, it often happens that a patient is subjected to the same test or investigation many times over. This can itself cause problems, for example because several blood samples are taken within a short space of time, or even the dangers of repeated exposure to X-rays.

The traditional Asian respect for their elders makes senior doctors much in demand. There are also the competing views of western and oriental medicine to obtain. Taken together, these lead to a certain conservative nature and attitude in the healthcare sector that mainly emanates from clinicians and pharmacists. However, technology is also held in high esteem. We were told the story of an employee at the British Embassy who had a headache in the morning and who took herself off to hospital to have a CT scan performed that afternoon!

The healthcare sector in Korea is very enthusiastic about IT solutions. However, like other service industries, the healthcare industry in Korea has always been relatively underdeveloped, and therefore could benefit from UK expertise on topics such as service delivery.

The Government made a change to the law in 2000 that forced a separation between doctors and pharmacists. It is no longer possible to dispense the medicines that you have prescribed (or vice versa). In the past, this had been a common occurrence, but had led to increasing allegations of malpractice.

The practice of telemedicine is inhibited by a 50-year old medical law that only recognises medical consultations where the doctor is able to examine the patient face to face. Telemedicine in Korea is therefore technically illegal, and practitioners face fines and even imprisonment. However, the law is openly breached, including by institutions that are funded by the government effectively to do so. Moves to change the law are under way and will probably bear fruit within 6 months (see section 3.2 below).

3 Telemedicine in Korea

Telemedicine is gradually gaining a foothold in South Korea, but by no means could it be said to be a common form of healthcare delivery. The people we met were primarily pioneers – people who are conducting pilot studies on how best the technology can be used. Some, however, have identified a market for telemedicine, and are looking to make money from it.

3.1 Primary care consultations by telemedicine

Professor Yoo Tai-Woo at Seoul National University[5] Hospital Telecare Centre demonstrated to us first-hand his use of a video-conferencing link with patients located at a company about 100 miles away. The system integrates the video image with the medical records of the patient, allowing the doctor to type entries, order investigations and prescribe drugs as he speaks to the patient. As well as video conferencing, the use of a remote oral examination and stethoscope was demonstrated.

The demonstration we saw was of family (general) medicine. Obviously, the consultation was carried out in Korean but screen documentation was a mix of Korean and English. The consultations were 'low tech' – prescribing drugs for hypertensive patients.

Government funding supports the project. Professor Yoo noted that, using telemedicine, he saw only 15 patients in 3 hours, compared with 60 he would typically see in the same time in a consulting room. He anticipated that, with more experience, he could increase that rate to 20-30 in a 3-hour session. It is doubtful whether a strong business case for this means of general practice could be made, but it does serve to illustrate the use of the technology.

At present, the number of patients seen using the system is very limited. Four home-based patients pay W6000 (£300) per annum for an unlimited number of consultations with Professor Yoo. Other patients resulted from a "barter" arrangement with companies who provided telecommunications connections.

Professor Yoo's long-term ambition is to see the use of mobile telecommunications to provide a "go anywhere" system. He is clearly an enthusiast for the greater use of technology in the delivery of healthcare, and an evangelist for telemedicine.

3.2 District health systems

We visited Yonsei University Hospital. Yonsei claims to have the number one rated medical, dental and nursing schools in Korea. We were there at the invitation of Professor Chae Young-Moon of the Graduate School of Health Science and Management (http://ghsm.yonsei.ac.kr). The School consists of nine departments including health informatics, international health and health law.

Professor Chae has been working in the area of District Health Management Information Systems (DHMIS) for about 10 years, and gave us a presentation on a national project he is involved with to develop them in new directions. He has researched similar approaches to DHMIS from around the world and has selected what he considers the best practice in each of the sectors of the system.

In Korea, the district health services consist of:

- 1300 Public Health Centres (each serving a population of around 5000), of which about 50% already have computer systems installed

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[5] http://www.snu.ac.kr

- 2000 Health Posts, mainly in remote areas, run by Community Health Practitioners (i.e. nurses), which are each responsible for about 1000 people

The demands of district health are changing. The pattern of disease has changed from acute epidemic diseases to chronic degenerative diseases. There is growing pressure for healthcare reform in the country and the 1995 Health Promotion Act has led to increased demand (2% of Korea's Tobacco Tax is allocated to health promotion). There is a need for community outreach programmes, particularly in mental health where the 1995 Community Mental Health Act had moved towards de-institutionalisation (cf. the UK's "care in the community"). There is also an aim to strengthen the role of health centres by establishing health promotion and community mental health functions within them. It is an objective of the ruling Millennium Democratic Party to have telemedicine in all 2000 of the health posts.

The objectives of the new DHMIS include:

- *Health screening* – automating the processing of data from physical examinations and the construction of a lifetime health record for residents. A pilot project has already shown considerable benefits, with a 92% agreement between an automated screening system and doctors' diagnosis.
- *Health education* – supporting health education and distance learning, and disseminating up-to-date news via the Internet. Courses in diet and nutrition, smoking cessation and maternal health have already been developed.
- *Visiting Home Services (VHS)* – supporting patients who have difficulty in getting to a health centre. Nurses making home visits carry a notebook computer that provides a videoconference and data telemedicine link from the patient's home via the telephone line to a doctor at a health centre or university hospital. A need for a decision support system has been identified. This would be to analyse the current status of patients, analyse the actions of the VHS in respect to them, evaluate the outcomes of their care, etc.
- *Community Health Services* – constructing a mental health registry and supporting patient management (e.g. for cases of depression). A research project comparing face to face and telemedicine consultations for schizophrenia patients showed a significant improvement in symptom identification and patient satisfaction for the telemedicine link. Another project showed a reduction, by using telemedicine, in the number of hospital visits made by elderly patients.

The DHMIS system should be available in all health posts by 2004 at a cost of W6b (£3m). Samsung SDS is the main technical development partner.

The long-term aim is to develop a network that links together all parts of the national healthcare infrastructure. The main goals of this are reduced costs, improved service quality, improved access, and improved productivity. That network will include:

- the National Registration Network (which supports the issuance of national identity cards, etc.)
- the networks that support the health insurance system
- laboratory systems (e.g. for pathology test results)
- pharmacies
- hospitals and clinics
- government health statistical services
- provincial/city government systems used for infectious disease control
- national pension agency
- patients

Some of this integration is being piloted in the "Healthy City Pusan" project being undertaken in South Korea's second largest city. This is a project funded jointly by the Pusan city government and the national Ministry of Telecommunications to the tune of W2b (£1m).

The core data for the system comes from the two-yearly physical examination that is mandatory for each citizen under the national insurance scheme. This includes a lifestyle questionnaire that covers topics such as smoking.

Professor Chae is clearly a visionary in the development of improved health and welfare services in Korea. He is highly respected both by healthcare professionals and by government planners. He has produced a persuasive business case to demonstrate the potential benefits of adopting new systems. He has recently completed a study considering the legal aspects of health informatics. His recommendations, which include giving legal recognition to electronic medical records and telemedicine (see 2.7 above), authorising healthcare websites and steps to expedite e-commerce in the health sector, look set to be adopted within six months.

3.3   National and international referrals

We visited the telemedicine clinic operated by WorldCare Korea based in the premises of the Youngdong Severence Hospital, part of the Yonsei Hospitals group. We met Mr Kim Kwang-Ho (Vice President, Operations) together with a number of his colleagues and Professor Sohn Young-Mo, Director of Paediatrics at the hospital.

WorldCare Korea (http://www.worldcare.co.kr) is part of the WorldCare group of companies, founded in the USA but now with a presence in 12 countries on five continents. The Korean company is owned by Kunhg Wa (also spelled Keun Wha), the oldest Korean pharmaceutical company. However, WorldCare Asia owns a portion of the pharmaceutical company. WorldCare Korea was established in May 2000, and the clinic facility in the hospital has been available since January 2001. However, because of the legal prohibition on telemedicine (see section 2.7 above), it is not able to actively seek business in Korea. The past 2½ months had been used to set up the facilities and to consider issues of quality of service. The company currently employs seven people. It was felt important to take things carefully, particularly because of the legal and regulatory issues of telemedicine in Korea.

At present WorldCare Korea profile their business as a doctor-to-doctor service, allowing local doctors to consult with overseas doctors. They basically provide a service that enables remote access to a "second medical opinion" to give better care for patients.

In Korea, they are currently working with Yonsei University College of Medicine. Internationally, they have links with the four US hospitals that founded the WorldCare group: Massachusetts General Hospital, Duke University Hospital, Johns Hopkins Hospital and the Cleveland Clinic. Currently they are relaying information to the US but want to set up an interregional network, so that they can send cases to Japan. Yonsei affiliated hospitals are interested in providing a local region service.

Additional services envisaged include a clinical trials service and the WorldCare Foundation for Distance Learning. Regular access to Continuing Medical Education (CME) will be available using a Virtual Private Network. The user will pay for this service. A password controlled access system will be used and the education programmes will be developed by the hospitals.

Kim Kwang-Ho explained that from a marketing perspective and when describing it to doctors, WorldCare Korea is promoted as providing a 'mutually beneficial' service. It brings medical advances to the local doctors. It provides the local doctor with 'an avenue for

alternative solutions'. Although a second opinion can be provided by this service, it is the local doctor who makes the ultimate decision. He believes that as a result it educates local doctors and shows them how patient care can be improved. He felt it would be important to integrate telemedicine into local communities and provide a role for the hospitals.

WorldCare Korea will sell their service on a capitated insurance product basis. In Korea, they have so far processed only three cases, which they sent to the US. It is hoped that national insurance will cover hospital telemedicine practice. Worldwide, WorldCare have processed 10,000 cases for a second opinion. In 85% of cases, the initial diagnosis was confirmed and over 75% of second opinions suggested an alternative treatment approach.

When asked about the current legal status of telemedicine, Kim gave a very positive response and said that he believed that the Korean National Assembly would pass a bill by June to legalise the practice of telemedicine and clear it of regulatory hurdles. This seems consistent with what we heard from Professor Chae (see section 3.2).

Although telemedicine will take time to become accepted, WorldCare Korea felt it important to accommodate the requests of the medical profession in order for it to be successful. There is, as yet, no fixed price structure set for a second opinion, however a charge of W2m-3m (£1000-1500) per case is foreseen. WorldCare Korea has projected that they will be profitable by the end of 2002.

WorldCare's network infrastructure will vary from country to country. In Korea, they intend to use ADSL, whereas in Malaysia it will be ISDN lines. The software being used, OpenMed, has been FDA approved. There have not been any security issues to date – OpenMed is fully encrypted.

WorldCare Korea's competitors include a company called "2nd Opinion", based in Tel Aviv. However, they are not active in Korea. The company did not believe they had any direct competitors, however, they mentioned a company called Soma Korea who provide a second opinion and are affiliated with a number of institutions, including UCLA and UC Davis.

The observation of the mission members was that WorldCare Korea is currently a small operation in its early stages, and obviously needs to solve some teething problems, as well as awaiting a change in the legal position regarding telemedicine. WorldCare's business model, based on the premise that patients are willing to pay for a service that allows them access to a second opinion, could be seen to reflect the Korean's perspective of Western medical practice/expertise.

3.4   Medical records via the web

We visited a relatively new start-up company called MD Saver in their headquarters in the basement of the Seoul National University Graduate School of Public Health. Professor Ok Ryun-Moon, Dean of the School, welcomed us, before handing over to the staff of MD Saver, led by Dr Hwang Wook-Bae, President of the company.

In the company's name, "MD" stands for "medical data". The business of the company is to provide clients with, to use their phrase, a "safe deposit box for your health" – specifically the client's medical records.

MD Saver (http://www.mdsaver.net) is essentially a centralised database on which medical records can be stored and accessed. Within Korea, the health service is fragmented into a large number of private hospitals and other medical centres that each has electronically stored patient information that cannot be accessed by the others. Members of the public can pay to have their medical records stored on the MD Saver system. These records can then be

accessed by all supporting organisations (it is assumed that all providers of medical information will exchange information with MD Saver), using a web interface.

The proposed system has two big advantages. In the first place, patients will have their records available at whatever hospital they attend. In the second place, it is believed that the approach will reduce the amount of "shopping around" for the most favourable diagnosis that is common in Korea.

Features of the approach included:

- Patients own their records and their permission is required for both storage and retrieval.
- Initially the company is aiming to involve 50-60 hospitals.
- They propose that customers in the initial year of the company's operation will have access free of charge, but the business plan calls for charge of W2100 (£1.20) per access. One charge may cover all accesses relating to a particular episode of care – this was a detail that had not been finalised.
- The aim is that profits would go to member hospitals and that is the driving incentive for their participation.
- The intention is to use PKI for encryption and authentication.

MD Saver is driven by medically qualified staff and as such is well adapted to meeting the 'medical' objectives. There could be concern, especially with the Korean culture, that the technical issues are insufficiently considered. Of special concern would be scalability and the total security environment (in which data backup is included).

3.5   Rural telemedicine

As part of our visit to Samsung Medical Centre (SMC[6] – see also section 4.3), we met with Professor Kim Dae-Joong, Associate Professor in the Division of Nephrology and Faculty Information Task Force Head.

Some patients treated at SMC are drawn from communities several hundred miles from the hospital, in some cases taking up to two days to travel to the hospital. This is the motivation for more convenient medical care. Telemedicine, as defined by Professor Kim to be cooperation between doctors in the SMC and those in rural areas, would fulfil this need. He believes that telemedicine can improve communication between specialist doctors and the primary care doctor, as well as aid communication with patients. It provides a simple means of sending clinical information to be used by either doctors or patients. At present, they are using video conferencing for face-to-face discussion and exchange of medical records. The patient's records, which include prescription data and test results, are stored electronically in the hospital. ISDN is being used as the network technology. ADSL is available but does not provide the necessary bandwidth in both directions.

Professor Kim is one of only two doctors at SMC using telemedicine at present. The other one is a doctor in the cardiac unit.

A pilot system has been underway for the past year, connecting three remote hospitals to SMC. One of the hospitals is on an island off the southwest coast of Korea. So far, the system has only been used on 18 occasions with 11 patients. On average, a patient was seen once or twice per month using telemedicine. The primary care doctor involved was satisfied with the telemedicine system – he saw it as a means of building a good reputation for the local hospital, and wished the scheme extended to different areas of medicine. The patients who

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[6] http://www.smc.samsung.co.kr/e-home/index.htm

had used it were in general very happy with the system. Although, there were some minor complaints e.g. the need to change drugs following consultation with the specialist via telemedicine. In addition, because SMC is very efficient at delivering lab results, there were some complaints that the local hospital was less efficient!

The pilot study had shown up some technical problems. These included the inability to provide communication between multiple partners – it only allowed communication on a one to one interface. It was not possible to have more than one hospital online at the same time and to switch between them. These will need to be addressed since SMC wish to be able to expand the service to many other rural areas.

Currently, the system does not generate revenue, as patients are not being asked to pay for the service. A payment system will need to be introduced. The system gets round the legal difficulties encountered by other telemedicine systems by formally being a doctor-to-doctor referral service.

3.6 Telemedicine development in Korea

On our last day in Korea, we were privileged to be invited to attend a "Telemedicine Round Table" meeting at the National Assembly Building (the Korean equivalent of the Houses of Parliament) hosted by Dr Seok Nam-Gung, Chairman of the Government Policy Committee. The aim of the meeting was to discuss how the information age could bring improvements in medicine and public health.

As well as the mission delegation, the meeting was attended by the British Ambassador, Charles Humfrey, various members of the ruling Millennium Democratic Party, representatives of the Ministry of Health & Welfare and the Ministry of Information, representatives of Pusan Metropolitan City Government, Korean academics and people from MD Saver and related companies.

Figure 3 - The mission team at the National Assembly

Some of the issues that were raised during the meeting included:

- The mission members were asked to talk about their vision for telemedicine and how developments in the UK were progressing. Richardson presented his vision of "e-health" as a new way of looking at the provision of healthcare services. McCurry described some of the initiatives undertaken in the UK to promote health informatics generally and telemedicine in particular. Briggs described the UK's strategic view in terms of government policy, NHS strategy and the elements necessary to implement those. It was stressed that we were there to allow an exchange of information to take place, and that we were not there to tell Korea or Koreans what to do or how to do it.

- There was some discussion of the role that telemedicine could play in the "Pusan Project" – the aim to develop a new hi-tech community in Korea's second largest city. It was seen by many as an opportunity to pilot many of the ideas that could one day be deployed

throughout Korea. Some of those present were pressing for the national government to support the project both financially and politically. However, the fact that the national government and the Pusan city government are formed by opposing political parties appears to be an obstacle – at least until the next presidential election!

- It was pointed out that there were many stumbling blocks on the road to the large-scale adoption of telemedicine. One was a general lack of resources. Another was the fear of members of the medical profession of being "shown up", i.e. that greater use of technology would provide a basis for judging medical competence.

- Slightly different views were expressed by the representatives of the Ministry of Health and Welfare and the Ministry of Information. Health and Welfare expressed a conservative view – much discussion and thought was needed before large-scale telemedicine systems could be adopted. The Information view was much more radical – the network infrastructures and technologies exist; they need to be used!

- It was pointed out that the Health and Welfare master plan includes telecare.

- The development of shareable medical records is seen as an important element of the strategy to reduce the number of multiple tests that are often carried out on patients. The private sector is leading the way on this.

The meeting was extremely valuable in revealing some of the tensions that lie under the surface in implementing Korean telemedicine. Many of the subtleties were probably lost on the members of the mission team. It was clear that ownership of many of the issues fall between the two ministries (perhaps not entirely dissimilar to the UK!).

4 Clinical information systems

In recent years, a great many hospitals, clinics and pharmacies in Korea have installed computer systems to keep track of their patients. They are variously known as Medical Information Systems, Hospital Information Systems, Patient Administration Systems, Electronic Medical Record Systems and Electronic Patient Record Systems. A common feature is to also have a Picture Archiving and Communication System (PACS) included or alongside to allow images (such as x-rays and CT scans) to be associated with a patient's other details.

During our visit, we saw or heard about a number of these systems in operation. Some have been developed specifically for a particular hospital and it is hoped to sell the product on to others. In most cases, the system has been developed for a general market. This section reviews those we came across and the companies developing them.

4.1 Seoul National University Hospital

We visited Seoul National University Hospital[7] as the guest of Professor Choi Jin-Wook to see their new medical information system (MIS) in action. The hospital is one of the oldest in Korea. It was founded in 1899 as the Royal Hospital of Korea, becoming Seoul National University Hospital in 1946. It is really three hospitals: a general hospital, a children's hospital and a dental hospital.

The hospital has had order communication systems (OCS) since 1984 but realised it had to update its systems in order to overcome large shortfalls in billing for services. Estimates showed that the hospital was losing of the order of W100m (£50,000) per month (2-3% of turnover) because tests were not charged for, or because unapproved drugs were prescribed.

An investment of W10b (£5m) over two years has already been recouped. Current estimates are that the rate of non-reimbursement is down to 0.7%, and that whereas before typically the hospital would hold 3-6 months of stock, that is now down to one month in many areas. The system generates warning messages whenever drugs are prescribed that are not reimbursable by the National Insurance scheme. Although not prohibiting their use, by this means they hope they will reduce their current expenditure of W4-5b (£2m) per annum on these items.

The system holds records on 2.5m patients, of whom 0.3m are active. The hospital sees on average 5000 outpatients per day and has 1600 beds. The systems supports 4000 staff of whom 1100 are doctors, 850 are nurses (a very low nurse:doctor ratio compared with Britain) and 76 pharmacists. The software was developed jointly by the hospital and Samsung SDS (one of Korea's largest software companies) and they are jointly marketing it to other hospitals in the country. Development took 18 months for the main phases (introduced in October 1999), though some components are yet to be completed. Currently, only the radiology department has a PACS system (developed in Korea by Marotech[8]), but this will be available hospital wide by June.

The goal is to achieve what they call the "4-Less" concept:

- Slip**less** – no slips of paper passed around the hospital – already achieved
- Film**less** – all radiology images to be digitised – completion scheduled for June 2001
- Chart**less** – all medical records online – future

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[7] http://snuh.snu.ac.kr

[8] http://www.marotech.co.kr

- Paper**less** – all other paper flows computerised – future

As well as clinical ordering, the system also embodies administrative (including payroll) functions.

Current implementation is based on Compaq Alpha servers and PC workstations. A project is investigating the use of PDAs. A Korean product (the JTEL Cellvic[9]) is being evaluated, as too are more widely known products such as the Palm Pilot.

4.2   Soon Chun Hyang University Hospital, Bucheon

We visited Soon Chun Hyang University Hospital in Bucheon[10], just outside Seoul. At the time we visited, the hospital and its 621 beds had only been open for about a month and everything was and looked brand new.

We were there as the guests of Mediface (http://www.mediface.com), the company that had provided the PACS system for the hospital. Mediface was founded in 1994 to specialise in the development of PACS and telemedicine systems. Its PACS system is in full use in 25 hospitals in Korea, with a further 12 in the pipeline. 17 Korean hospitals use their products for part of their imaging needs. Mediface are also keen to market their products overseas and list customers in the USA (10), Japan (9), Spain (4), Singapore (1) and the UK (1[11]). Their system is 100% DICOM compliant.

According to Mr Cheong In-Ho (International Marketing Team Leader at the company), the system at Soon Chun Hyang had been installed over a pe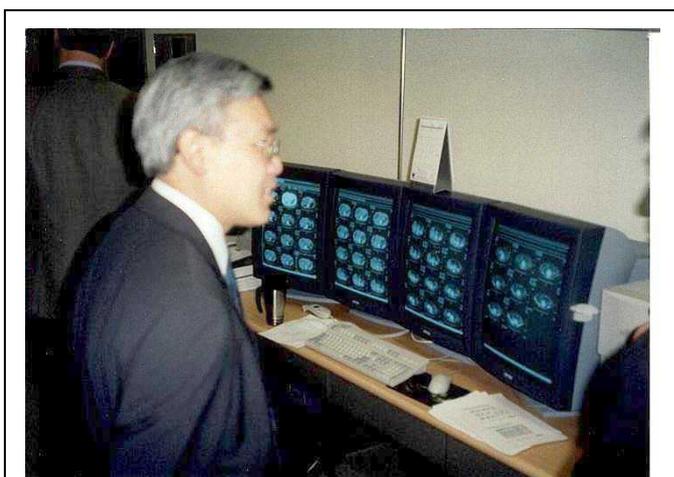riod of three months at a quoted cost of W3.8b (£1.9m). It comprises 33 input devices covering 13 modalities of image, including MRI and CT scanners and 8 ultrasound machines. There are 250 workstations situated around the hospital that can be used by clinicians to view the images. 11 specialist workstations in the radiology department are used for diagnosis. Typically, any image can be accessed with only a 3-second delay. Reports on images can be added in the form of either text or audio. The imaging system is linked bi-directionally to the hospital's information system (a product from the Korean company ICM[12]).

Figure 4- Hong Hai Seeto inspects the PACS system at Soon Chun Hyang University Hospital, Bucheon

The system is hosted on a cluster of two Fujitsu servers, with two Sun servers used for the HIS. Data is held in a 1TB RAID, which they expect to fill in two years.

The specialist workstations used for diagnostic viewing are known as PiView (also written as πView). These are Windows 98/NT/2000 based DICOM workstations that can acquire,

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[9] http://www.jtel.com

[10] http://www.schbc.ac.kr

[11] The University of Sheffield has bought one of their PiView workstations.

[12] http://www.icmnet.co.kr

display, archive, transmit and print medical image data. These can be used in conjunction with any DICOM standard PACS system.

The architecture of the Mediface PACS system includes an Internet gateway that allows images produced elsewhere to be viewed in the hospital, or vice versa. They provide a web-based PACS client/server system among their products.

4.3   Samsung Medical Centre

Samsung Medical Centre (SMC)[13] is one of the biggest hospitals in Korea.[14] It was opened in 1994. It has 38 major clinical departments, 110 specialist clinics, 1263 hospital beds, 80 outpatient clinic examination rooms, 800 doctors, 1000 nurses and a helicopter air ambulance. Approximately 5000 patients are seen in the hospital per day, with an additional 1200 inpatients. A typical fee is W2500-4000 (£1.50-2) for a consultation with a doctor. An annex to the hospital is currently being built to facilitate expansion.

SMC became recognised as a teaching hospital in March 1997 and has an active continuing medical education programme. This includes a problem based learning system. Understanding health informatics systems such as PACS is regarded as an important part of postgraduate medical training within the hospital.

Mr Lee Sa-Beom showed us their Hospital Information System. This has six main components:

- Critical Information System – giving doctors the ability to order tests and treatment
- Management Information System – providing support for procurement, finance and inventory
- Critical Research System – providing clinical information
- Clinical Automation System – linking to laboratory systems
- Distribution and Automation System
- Office Automation System

The system runs on a cluster of four Compaq servers. There are 2200 computer terminals installed in the hospital.

The hospital has had a full PACS in five departments since 1994. Since then, they have changed the system three times, with the most recent being to a GE product – a switch that was done to ensure Y2K compliance. Installing the current system has made substantial cost savings; reducing from W20b (£1m) to W400m (£200,000). PACS has been used for more than 240,000 patients.

SMC uses GE MRI and CT scanning equipment and Philips X-ray machines. X-ray images are compressed down to one-tenth size.

4.4   Medidas

Medidas was founded in December 1994 and had its origins in a research programme at Seoul National University Hospital. It was listed on the Korean stock exchange on 2nd May 1997, and now employs 190 staff with a market capitalisation of W88b (£44m). Our visit there was hosted by Mr Kim Ree-Suk (Isaac), Chief Financial Officer and head of international business.

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[13] http://www.smc.samsung.co.kr/e-home/index.htm

[14] See also section 3.5 for details of SMC's telemedicine work.

Medidas (http://www.medidas.com) does business in three areas:

1. Electronic medical records software

2. Medical electronic commerce

3. CyberHospital software

4.4.1 Electronic medical records

Medidas produce two EMR systems that each have a large market share within Korea.

The first ("Ysarang") is essentially practice management software for small hospitals and clinics. Of the 19,000 clinics in Korea, Medidas currently has a 70% market share of those that use practice management software (not all clinics are equipped with electronic medical records) and claims that 4,600 clients are utilising their solution at present. This figure is rising.

Medidas also equip Pharmacies with a similar software package called "@Pharm". Of the 18,000 pharmacies, Medidas enjoys a 50% market share of users with 4,500 clients. Their only competition in the pharmacy market is the Korean Pharmacy Association.

A demonstration of the EMR was given and was a standard electronic patient record with clinical features (symptoms and findings on physical examination), laboratory test results, and radiological images including video.

Medidas derive their revenues from this system as follows:

	Installation fee	Annual maintenance fee
Clinics	$2600	$400
Pharmacies	$300	$480

This market has been made by the recent medical reforms in Korea that separated the functions of medical practitioners and pharmacies. Only doctors can write prescriptions now, so that patients have to go to the pharmacy to buy the medication. The result of this change in policy has been a revenue loss to both doctors and pharmacies (as compared to the previous system). The solution for them is to invest in Electronic Pharmacy Management software that results in better inventory management, and electronic linkage between the clinics and the pharmacies – hence the growth in the market.

This market will greatly benefit from the reforms that the government is likely to pass this year. It is expected that electronic prescriptions will become legally recognised, electronic signatures on EMRs will be allowed and telemedicine consultations will become reimbursable from insurance.[15]

4.4.2 Medical electronic commerce

Medidas currently offer a B2B application providing a prescription transfer service between clinics and pharmacies. However, this application has been suspended since January 2001 until the government's policy is made clear.

Future B2B applications being offered include a network-managed service between Medidas clients and wholesale pharmaceutical companies and prescription EDI.

Revenues would come from charges to patients for each prescription of about W200 (10p). The pharmacies would have to pay for network-managed services.

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[15] These are basically the recommendations made by Professor Chae (see section 3.2).

4.4.3   CyberHospital

Medidas opened their CyberHospital (http://www.healthkorea.net) in June 1998 and have logged 1m patients to date. 600 doctors offer medical services through the service.

Services include a home-based telemedicine unit that provides telemonitoring services of blood pressure, pulse, ECG, an electronic stethoscope, spirometry, blood and urine analysis from the patient. The data is then up linked to the CyberHospital for review.

Transmission can be through a personal computer at home, a mobile telephone or a home based set top box. Medidas intend to develop a number of B2C services in the future, including:

- health information service
- second opinion service
- customised health care services such as "quit smoking in 21 days", "diet and fitness".

Revenues will come from advertising and from sales to companies with a large number of employees who have a vested interest in keeping their employees fit and at work. Medidas believe this is a major growth area.

4.4.4   Overseas activities

Medidas also have a number of activities in which they are engaged overseas.

Medidas have a subsidiary in China called Medidas Greater China Limited, which is poised to sell EMR software to hospitals. Chinese hospitals have received government instructions to start using computers and IT. EMR sales are expected to start from May/June 2001.

Medidas are in partnership with Invizeon, a US company. Invizeon's business is to build online directories for county medical associations, of which there are thousands in the US. This provides a communication tool between the medical association and the medical practitioners who are its members. In the future, they hope to sell a web based EMR product for all doctors, which would be charged for by a monthly fee. Medidas owns 10.8% of Invizeon.

4.4.5   Future Plans

Medidas are developing a smart card project in alliance with a company that has 7m credit card users.

Features of the smart card will include:

- Electronic Prescription storage
- EMR storage
- Authentication
- Easy payment by credit card
- Other e-services

Medidas is firmly committed to "Go Global", starting with China and the USA, and they are actively looking for strategic partners to go overseas. They are especially interested in the UK because of the English language and the similarity between the Korean and UK healthcare systems, which suits their existing product lines.

4.5 BIT Computer

Business Information Technology (BIT – http://www.bit.co.kr) is the leading medical information systems company in Korea. It was founded by a college student in 1983, and now employs 154 people of whom 43 are PhDs and 37 have masters degrees.

Assets were estimated as W64.1b (£32m) in June 2000. Growth was steady until 1995 but rapid growth has taken place in the last five years.

BIT has three main business areas:

- medical information off line
- medical information on line
- medical education

4.5.1 Major products

1. An **Integrated Hospital Information System** capturing administrative, financial, laboratory, radiology and clinical information.

   Of 850 hospitals in Korea, 250 are clients of BIT. (Of the others, 200 are conglomerate subsidiaries or Universities and the remaining 400 have no IT at present and so represent opportunities for growth.)

2. A **Practice Management System (**called Dr BIT) aimed at clinics. Of the 18,000 clinics in the country, BIT currently has its product in 5000.

   Dr BIT offers the following features:

   - Automatic update
   - Insurance re-imbursement
   - Immunisation management
   - Statistics
   - E-Medicals

   Revenues come from monthly fee collection with no upfront costs.

   Competitors include Medidas whose software is installed in 4500 clinics.[16]

3. A **Pharmacy Management System** is being deployed in pharmacies as a direct competitor to Medidas. This is currently used in 3000 pharmacies.

4.5.2 Other clinical products

BIT also sells software that has clinical applications such as:

4. **Dr PS –** Plastic Surgery Simulator, which simulates operations by virtual reconstruction of the operational site. It is used by plastic surgeons to show patients what the finished effect will look like. Although the current version is limited to cosmetic surgery, future versions will address multiple types of surgical applications.

5. **Dr Image**, which is an image management system (for photos, slides, charts, etc.) and has clinical applications in dermatology.

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[16] We were interested to note the similar views expressed by both Medidas and BIT, apparent competitors in the market for practice management systems. It turned out that BIT is the second biggest shareholder in Medidas. Medidas does not have a product for the hospital market.

6. **On Line Healthcare Information System**, which offers Prescription EDI and is taking advantage of the recent change in legislation where pharmacies are now placed outside the hospital or clinic.

7. **Health Group Card** (smart card), which will address public health information gathering, prescription EDI and payments for treatments, admission to hospital/clinic and dispensing.

8. **Disease Monitoring System (DisWeb)** which is a disease reporting system allowing for rapid public health surveillance across the nation initially set up in conjunction with the Ministry of Health and Welfare.

9. **Drug Information Website (Drug.co.kr)** that provides information on drugs. The main features are an electronic drug catalogue and an intelligent search capability with information on newly released drugs. The website provides a portal site for the pharmaceutical sector. They are currently registering 30,000 page views every day and the hit rate is increasing.

Revenue comes from advertising, an annual fee levied from the pharmaceutical companies; fees from hospital drug stores and content providers (mobile phone companies) are charged a fee.

4.5.3   Other activities

A further venture is an **IT Education Centre**. This began in 1990 and offers six-month courses. 4000 students have completed courses since 1990 and BIT put on 36 expert courses and register 1400 students a year, of whom 700-800 graduate. Access to these courses is very competitive with typically three applicants per place. The courses are supported by instructors from Seoul National University and KAIST.

BIT has joint ventures in Japan, China and Hong Kong and recently in Malaysia. These activities are mostly distribution agreements for BIT's products.

BIT is looking for strategic partners to sell their products into new markets such as the UK and Eastern Europe.

4.6   Samsung SDS

Samsung SDS (http://www.sds.samsung.com) is the IT services company in the Samsung chaebol. Established originally as Samsung Data Systems in 1985 with 63 employees and a turnover of W2.1b (£1m), it has grown into an international organisation employing over 6,000 and with a turnover of W1.2 trillion (£600b). Its services include IT consulting, systems integration, global network services, packaged software, information circulation and IT education. Their European office is in Brentford in Middlesex, and they also have offices in California, New Jersey, Tokyo, Singapore and Beijing.

Our visit was hosted by Miss Nami Kim, international marketing manager, and we also met members of the business integration division and a subsidiary company, Raypax.

In the healthcare sector, they have a number of products and services. The Total Hospital Information System[17] provides patient management, clinical support, hospital administration and clinical system functions. They also offer telemedicine solutions and point of care data entry systems.

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[17] Used at Seoul National University Hospital (see section 4.1).

Raypax develops and markets a PACS product under its own brand. This is a DICOM-compatible system, which includes medical image acquisition, image display and management, image diagnosis and reporting, storage management, patient examination scheduling, film digitising and printing, and interface to a hospital information system using HL-7 protocols. It has been under development for over 8 years, Raypax having been established as a separate company only since September 2000. Its features include that it is FDA approved; it has superior compression ratios (4:1 lossless); it supports the English, Japanese, Chinese and Korean languages; it has an Internet interface to make telemedicine possible; and it incorporates a so-called "Teaching File System" for educational purposes. It will run on a wide range of servers (either Windows NT or Unix), and supports a wide range of storage media including jukeboxes, CDs, DVDs and others.

Figure 5 - The mission team with their hosts at Samsung SDS

5 Other organisations visited

5.1 Korea Health Industry Development Institute (KHIDI)

Ms Chang Hye-Jung gave a presentation on the work and role of KHIDI[18], a government-affiliated institute. KHIDI was formed in February 1999 under the Korea Health Industry Development Institute Act. The Institute aims to enhance the competency of the national health industry and to promote and develop it as a strategic national industry. The long-term aim is to help it contribute to national economic development and to improve public health.

It has four objectives:

1. Guide the development of the health industry by acting as a think-tank for related policy.

2. Systematically develop the national health industry by providing development planning, supporting restructuring and innovative management, and supporting the foundation of new venture enterprises.

3. Facilitate collaboration between industry, academia, research institutes and the government, and acting as a contact point for international activities.

4. Construct the infrastructure for the promotion of the health industry by providing information bases for the market and the technology, supporting technology development and commercialisation and the training of health professionals.

KHIDI is resourced with a pool of professionals with diverse expertise, and undertakes the following major activities:

- *Development of policy for the promotion of the health industry*. This includes policy for technology development and information, for the improvement of management, for the quality of improvement of health products and services. The Institute rationalises regulations by reviewing suggestions and bottlenecks in the management of enterprises, and provides government with reference materials for policy development on current issues.

- *Promotion of technology in the health industry*. This includes the analysis of technology trends and forecasting future technology, planning for R&D strategy and programmes, health technology dissemination and transfer, and supporting the foundation of the "Health and Medical Science Technopolis" at Ohsong.

- *Information Service and Networking*. This includes providing information on international and domestic technology, market and management through the Health Industry Information Centre,

- *Information standardisation*; including collaboration on HL-7 (Health Level 7)[19] collaboration, bar coding and related guides and protocols, and holding symposiums, seminars and forums and publishing reports and newsletters.

- *Improvement of health industry management.* This includes evaluation and support for venture enterprises, a consulting service for management and technology, restructuring of distribution systems and the development of new health industry areas.

- *Quality improvement.* This includes the certification of quality (the GH emblem for "good of health") for pharmaceuticals, medical devices, food and cosmetics, laboratory analysis, evaluation and monitoring of hazardous materials, and technical support for hygiene

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[18] http://www.khidi.or.kr

[19] http://www.hl7.org

management, service evaluation of healthcare institutions, a national health and nutrition survey and consumer protection activities.

- *Education and training.* This includes short courses on many aspects of health services management, on hygiene for the food industry, on knowledge management for the pharmaceutical industry, and on research and development.
- *International collaboration.* The Institute undertakes strategy development for international trade negotiations and support for exploring global markets. It collaborates with international organisations such as WTO, OECD, UNCTAD, WHO, FAO, ISO, etc. It also provides support for training abroad and the education in Korea of people from developing countries.

Other topics that arose during discussion included:

1. A standard for patient record keeping is an active issue.

2. KHIDI was participating actively in ISO TC 215, the Working Group on standards for smart cards in health.

3. Comparisons were made with other SE Asian countries. It was considered that Korea was some five years behind Japan in health developments.

4. Ms Chang's conclusion was that attitudes to healthcare were changing in Korea.

The best way to sum up KHIDI is to say that it is an advisory body to Government with some functions similar to those of the Information Policy Unit of the NHS Executive.

5.2 Macrogen

We visited Macrogen (http://www.macrogen.com) at the invitation of James Kim. Macrogen is a company in the biotechnology sphere whose main activity is related to genomics (the science of genes). They currently make and sell DNA chips to Korean researchers and sell data based on their bio-informatics research to pharmaceutical companies. One part of their work is the development of the so-called "Knockout mouse" – a mouse whose genetic makeup has been modified by the exclusion (knocking out) of one gene in order to try to identify its function. Current technology means that it takes about a year to do 300 such tests (i.e. 300 genes). Macrogen's technology could improve that productivity by a factor of 10. Given the number of genes involved (of the order of 30,000), and all the possible permutations of them, this is an area of work that will take years to complete.

Macrogen are also planning to introduce a telemedicine service whereby tests for specific disorders signalled by genetic anomalies will be carried out. However, the company were unable to give us more details of this pending a commercial announcement later in the month.

6 Summary and conclusions

6.1 The political and economic environment

Our impressions of the political and economic environment were generally positive. South Korea is a country with a phenomenal success rate for economic expansion. It has a successful IT sector that is leading the way in the sort of economic reforms that are necessary for the long-term growth to be sustained. Although the political and governmental systems do not work precisely like our own, it is possible to make things happen there.

The Korean economy is susceptible to the effects of outside forces, particularly because of its close trading relationships with the USA and Japan. However, these are no worse than anywhere else in the Far East, and Korea shows signs of attempting to diversify its customer base. In this regard, Britain provides a good base for developing new relationships with Europe.

The companies we visited or heard about during our visit can be classified in three categories. Each has a different outlook and development path.

1. Korean companies trying to develop a domestic market. The support from the government for things like hospital information systems has boosted the opportunities for companies to develop home-grown products to compete with the big international players. The government appears keen to support R&D activities and as long as this is the case, there will be plenty of scope for indigenous companies to develop their markets.

2. Korean companies trying to develop an international market. Korean companies are keen to prosper outside their immediate sphere of operations. While Japan is the obviously nearest overseas market, there is a desire to spread more widely afield. Malaysia was a country named by more than one person we met. China is also big on Korean companies' minds simply because of the tremendous growth opportunities there. Europe and South America are also being targeted.

3. International companies trying to develop in the Korean market. While Korea is good at many things particularly in manufacturing, there is still much scope for development in the service sector. Both government and business are striving to develop new services for an ever more affluent population. While many Koreans would like to think that these services can be created by their fellow countrymen, many in business recognise that the lessons that they need to learn have already been learned in the USA or Europe, and can shortcut the time to develop a service by borrowing on this expertise.

6.2 The healthcare environment

It is clear that there are changing expectations about healthcare on the part of the general public. While the traditional forms of oriental medicine are still practised and respected, there is a rapid rise in demand for "western" medicine and the technology that accompanies it. This is not to replace traditional practices, but to supplement and support them. It is not a case of one taking over from the other.

The Korean habit of seeking multiple diagnoses provides a number of business opportunities for companies that want to offer services to facilitate the sharing of information about the patient. We have seen from our visit the proliferation of information systems within hospitals. That is being extended so that information can be shared among different hospitals within the same group. The next step, as typified by MD Saver but also referred to by others that we met, is to facilitate information sharing from the patient's point of view, rather than the healthcare providers'. The obvious desire of a patient to reduce the number of needles stuck

in them, or the number of times they have to undergo a scan, is matched by the desire of the national insurance scheme not to have to pay over and over for these tests.

Telemedicine is opening up a number of doors to support this. We saw systems that allow the patient's information to be moved from place to place. We also saw systems that allow a doctor to interview a remote patient. These sorts of examples are of obvious benefit to people who live in rural areas or away from the national centres of healthcare expertise in Seoul. However, given the traffic problems in travelling from one part of Seoul to another, people in the city will also choose telemedicine simply for its convenience.

It is clear that the trend in medicine is towards more specialist centres of expertise – this is the case at local, regional, national and international levels. The patient wants to be seen (either physically or virtually by telemedicine) by doctors with the greatest experience, expertise and reputation for their condition. Korea seems to have the healthcare business model in place to take advantage of this. Once the law prohibiting telemedicine is changed, any Korean will be able to go to any doctor. This contrasts with the decidedly local focus of our NHS.

Like in North America, telemedicine in Korea appears currently to be focussed on only two things:

- videoconferencing consultations so that patients can get access to remote doctors without having to travel to them
- exchange of medical records so that a second or subsequent doctor to examine a patient does not have to repeat tests performed by previous doctors that the patient has consulted

There was much less evidence that we saw of the "store and forward" type applications that is popular in Britain and many parts of Europe. This perhaps reflects a stronger reliance by the patient on wanting to see their doctor face-to-face (albeit by television) rather than consigning their symptoms to a more anonymous service. Service driven structures prefer the latter because they tend to be more cost effective. That is not the Korean way.

We did not see much evidence of telecare, though Professor Chae spoke about the telemedicine support for nurses visiting housebound and mentally ill patients. Without having the opportunity to talk (for example) to elderly people, or the people who care for them, it is difficult to assess what the demand for such services might be.

It would appear from the impressions gained during our visit that new developments in healthcare service delivery are *commercially* driven from the provider end. Hospitals provide new services because they can make more money out of them. Having said that, there is clearly a growing demand to meet their supply. Technology is available to do many valuable things, but penetration into the market place is still lacking and there are problems in consumer awareness. The software currently available is fragmented around niche activities, though the Internet is providing a means to integrate systems. This may be ultimately be overcome by companies forming partnerships and alliances.

The legal bar to telemedicine looks to be about to be lifted, and the government seems also about to give legal recognition to other technologies such as digital signatures that will enable the expansion of developments in this field. Korea may be on the verge of an explosion of telemedicine services. It will be interesting to observe what happens.

6.3   Opportunities for UK companies in Korea

We have identified two main areas in which British expertise could be of direct and immediate benefit to the Korean healthcare sector.

6.3.1 Healthcare education

The recent change in South Korean government policy concerning the division of prescribing and dispensing has led to a significant opportunity to provide medical education for both the pharmaceutical industry and health professionals. The pharmaceutical industry in particular will need to invest time and money on educating their sales representatives about the therapy area they will be working in. The recent developments in IT have opened up various avenues by which medical education programmes may be developed and delivered to the pharmaceutical industry.

There are also considerable opportunities for the pharmaceutical industry to sponsor education programmes to health professionals. Such sponsorship would enable companies to raise awareness of medical conditions and relevant treatments. Therefore, companies such as Healthcare Education Services Ltd (one of the mission participants), that deliver education programmes either as live events or distance learning, have the potential to build a business enterprise working with pharmaceutical companies in Korea. Healthcare Education Services Ltd is actively engaged in identifying potential business opportunities in Korea and is currently working in collaboration with a small, specialist marketing agency.

6.3.2 Healthcare service delivery

In the UK, the provision of healthcare services is underpinned by two fundamentals:

1. Evidence based medicine – the notion that care and treatment should be based upon solid evidence that what is prescribed is the best for the patient's particular condition.

2. Efficient service delivery – the notion that care should be provided in a cost-effective manner as well as a clinically effective one, and that resources should not be wasted.

South Korea does not have the equivalent of the UK's National Institute for Clinical Excellence (NICE) to develop guidelines for clinical practice. As far as we are aware, there are no national initiatives to implement clinical governance or to standardise on particular care pathways. In view of the "multiple opinions" that many patients seek, such standardisation may reduce costs enormously.

There is also a quality of life issue. This is gaining increasing importance among Koreans as they observe the expectations that citizens of western countries already have about their health and well-being.
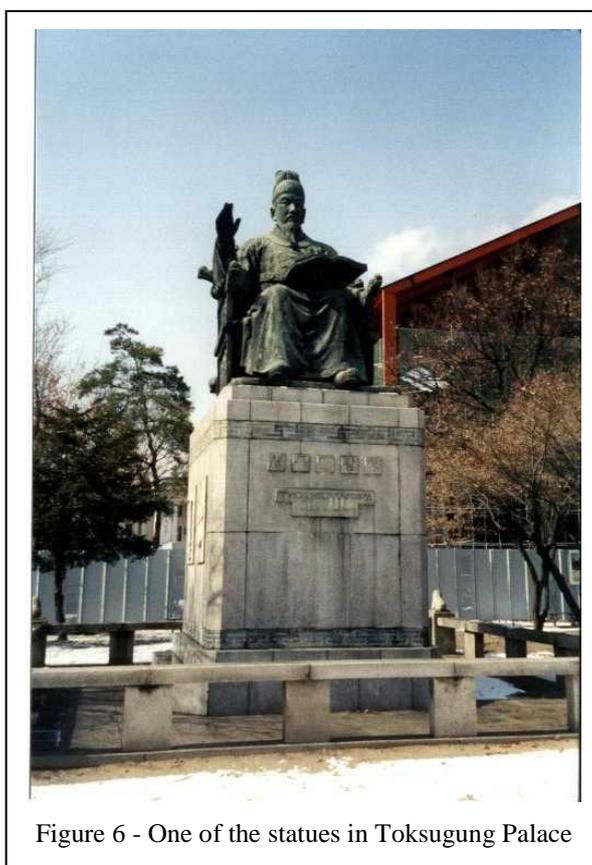
There are opportunities for consultants who specialise in the design and re-engineering of healthcare service delivery to apply their expertise to the Korean model of medical care. Where those people can also apply their expertise to clinical effectiveness, there will be a double benefit to the patient.

6.4 Recommendations

As the result of our mission, we make the following recommendations:

1. There is almost no current contact between the UK and Korean health sectors and as a result, neither can take advantage of experience gained in the other. In this respect, the balance is probably in the UK's favour – there are more examples of service delivery in the UK that might prove beneficial to the provision of healthcare in Korea than vice versa. We recommend that key players in Korean healthcare be identified and invited to the UK to see how we do things.

a) From among the people we met, Professor Chae would seem to be a candidate for this because of his involvement in several telemedicine and other health informatics projects, and because he has the ear of the South Korean government.

b) A number of members of the Korean Society of Medical Informatics are going to be in the UK for the MedInfo 2001 international conference in September 2001. That would be a good opportunity to show them some of the best features of the NHS.

2. We did not see first-hand any examples of telecare in Korea, and Professor Chae was the only person to refer to it directly. This may provide an untapped market for UK expertise and we recommend a follow-up visit by a small group to explore that in more detail.

3. We were not able to find out as much as we would have liked to about the use of smart cards in Korea. This may be a topic for a future mission to explore.

4. It is unlikely that in the short term any British company would be able to break into the Korean market for hospital information systems, PACS systems or basic videoconferencing – the Korean market for these is relatively well established. Better opportunities may exist in other Asian countries.

5. However, Korea does have the technical infrastructure in place that is necessary to underpin a wide variety of service-driven activities. We believe that in the areas of education, consultancy and the provision of service-supporting IT systems, Korea has much to learn from UK companies. Support should be provided, perhaps in the form of a trade mission, for the development of further contacts in this field.

Figure 6 - One of the statues in Toksugung Palace

Appendix A – Bibliography

The following is a list of books and websites that the mission members found useful in planning their visit to South Korea.

Britain in Korea. Website run by the British Embassy in Seoul. http://www.britain.or.kr

CIA World Factbook 2000 - South Korea, http://www.odci.gov/cia/publications/factbook/geos/ks.html

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Appendix B – Publications on Korean telemedicine and health informatics

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Appendix C – Glossary of terms

ADSL	Asymmetric digital subscriber line
B2B	Business to business
B2C	Business to consumer
CME	Continuing medical education
CT	Computer-aided tomography
DHMIS	District health management information system
DICOM	Digital Imaging and Communications in Medicine
DTI	Department of Trade and Industry (UK)
ECG	Electrocardiogram
EDI	Electronic data interchange
EMR	Electronic medical records
EPR	Electronic patient records
FDA	Food & Drug Administration (USA)
GDP	Gross domestic product
GNP	Grand National Party (South Korea)
HIS	Hospital information system
HL-7	Health level 7
ICT	Information and communication technologies
ISDN	Integrated services digital network
IT	Information technology
MDP	Millennium Democratic Party (South Korea)
MIS	Medical information system
MRI	Magnetic resonance imaging
OCS	Order communication system
PACS	Picture archiving and communication system
PDA	Personal digital assistant
PKI	Public key infrastructure
R&D	Research and development
RAID	Redundant array of inexpensive disk
SMC	Samsung Medical Centre
SME	Small/medium sized enterprise
ULD	United Liberal Democrats (South Korea)
VHS	Visiting home services