



# Capabilities

Communicating the Science of Prosthetics and Orthotics

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## A Learning Experience in India

By Andrew Hansen, Ph.D.

Recently I had the pleasure of traveling to India to learn about some of the technologies that are used there to fabricate lower limb prostheses. I traveled with Dr. Yeongchi Wu, Research Director at the Center for International Rehabilitation (CIR) in Chicago, and Mr. Hector Casanova, Vice President of Field Programs at the CIR.

Our group began our Indian experience in Delhi, where Mr. Tarun Kulshreshtha, a sincere and dedicated prosthetist and orthotist, met us at the airport at two o'clock in the morning! Mr. Tarun escorted us to our hotel for a few hours of sleep after which we departed for Jaipur. Our host kindly escorted us the long route to Jaipur via the city of Agra so we could see the Taj Mahal (Figure 1).

We spent one day in Jaipur at the Bhagwan Mahaveer Viklang Sahayata Samiti (BMVSS) Clinic where we learned about their methods of

fitting trans-tibial prostheses and how they fabricate the Jaipur Foot. While in Jaipur, we shared information regarding technologies that we have developed at the Northwestern University Rehabilitation Engineering Research Center (RERC) and at the CIR, including the Shape&Roll prosthetic foot (Sam et al., 2004) and the CIR dilatency sand casting system (Wu et al., 2003). Also, we discussed distance-learning initiatives that are taking place at the CIR.



**Figure 1:** Researchers from the Northwestern University Rehabilitation Engineering Research Center (NURERC) and from the Center for International Rehabilitation (CIR) recently traveled to India to learn about prosthetics technology there and to share information about research and development projects. Shown sitting in front of the Taj Mahal are (from left to right) Mr. Hector Casanova of the CIR, Mr. Tarun Kulshreshtha of the Bhagwan Mahaveer Viklang Sahayata Samiti Clinic in Delhi, Dr. Yeongchi Wu of the CIR and Dr. Andrew Hansen of the NURERC.

Our session of information sharing, demonstrations and discussions continued late into the evening hours. It even included the fabrication of a Jaipur trans-tibial prosthesis. Early versions of the Jaipur limb had utilized aluminum for the socket and shank part of the prosthesis. For many years a strong and light, high-density polyethylene (HDPE) pipe has been

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used for the socket and shank portion of the exoskeletal prosthesis. The personnel at the BMVSS Clinic demonstrated the fabrication of this limb, including casting, modification, drape molding, and assembly, in less than one hour (Figure 2). Their particularly elegant method of gait analysis used footprints after stepping in water; this demonstrated the symmetric gait of the person who was fit with the prosthesis.

From Jaipur we traveled next to Bangalore where Mrs. Ritu Ghosh, Assistant Director at Mobility India, graciously received us at the airport. While in Bangalore, we attended the “Workshop on Exchange of Information on Rehabilitation Technology and Disability Rights” that was organized by Mobility India and the Center for International Rehabilitation.



**Figure 2:** The master craftsman and an inventor of the Jaipur Foot, Mr. Ram Chandra Sharma, demonstrates the symmetry of a trans-tibial prosthesis. The exoskeletal shank portion of the prosthesis was made from a high-density polyethylene (HDPE) pipe. The prosthesis shown was fabricated in approximately 50 minutes (including casting, modifications, drape forming, and assembly) at the Bhagwan Mahaveer Viklang Sahayata Samiti Clinic in Jaipur, India.

Representatives from more than ten rehabilitation organizations within India and beyond attended this workshop. People who attended the sessions were interested in all the technologies presented by our group, particularly the dilatency sand casting system developed by Dr. Yeongchi Wu (Figure 3).

During the workshop, our group together with personnel from Mobility India cooperatively fabricated a prosthesis. Its socket was made using the dilatency sand casting techniques developed at the CIR, the pylon system developed by Mobility India, and the Shape&Roll prosthetic foot developed by Northwestern University Rehabilitation Engineering Research Center (NURERC) in collaboration with the CIR. The user of the prosthesis spoke highly of the limb, stating that he felt it had a natural, rolling action and was light in weight. Many of the attendees of the workshop offered positive comments regarding the gait of the individual who used the prosthesis and several suggested future collaboration with the CIR to test the sand casting

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**Figure 3:** Dr. Yeongchi Wu, Research Director at the Center for International Rehabilitation, demonstrates the dilatancy sand casting system to attendees of the “Workshop on Exchange of Information on Rehabilitation Technology and Disability Rights” at Mobility India in Bangalore, India.

and Shape&Roll foot technologies in their own clinics.

On my last day in India, I worked with others from Mobility India to fabricate a hybrid prosthetic foot, which was a combination of the Shape&Roll and Jaipur prosthetic feet. Numerous persons at the workshop and even some attendees of the ISPO conference in Hong Kong in 2004 had suggested this hybridization. The hybrid prosthetic foot contains the core section of the Shape&Roll prosthetic foot, which is designed to take the same rocker shape as the able-bodied ankle-foot roll-over shape during walking, and the vulcanized rubber covering of the Jaipur foot, which is very durable and has a pleasing cosmesis. Unfortunately, I had to catch my plane before the foot could be vulcanized. Since my return, the foot has arrived at our laboratory in Chicago where it will undergo further analysis.

In India, the professionals I met who are involved in prosthetics fittings, research and development seemed very knowledgeable and expressed a strong desire to help the large number of persons with disabilities. These professionals provide inexpensive or free prostheses and orthoses to the poorest people in India and to others through outreach camps in other countries such as Sierra Leone and Afghanistan. Moreover, they strive to improve their technologies toward the goal of fabricating and fitting the best

possible devices for the end users. In addition to their clear passion for helping others, their sincere and friendly hospitality toward our group from Chicago was unparalleled in my experience. We gained insights into Indian culture and experienced a fruitful exchange of information and technology. In the future we look forward to additional rewarding communications and possible collaborations.

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Wu Y, Casanova H, Smith WK, Edwards M, Childress DS, CIR Sand Casting System for Trans-tibial Socket. *Prosthetics Orthotics International* 2003 August 27 (2):146-152.

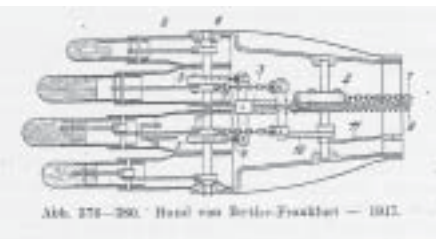
## Remembering Hans Bethe

The death of Nobel Laureate in Physics, Hans Bethe (aged 98), on March 6, 2005 reminded us of a connection between the Bethe family and a hand prosthesis.

Hans Bethe’s father, A. Bethe, was a physiologist who worked with human motor control and believed in the flexibility and adaptability of the neural system. In 1917, A. Bethe developed a mechanical, artificial hand based on the principal of flexible coupling. Mark L. Latash noted this in his book, *Progress in Motor Control, Volume One, Bernstein’s Traditions in Movement Studies* (1998, pages 111-113). A diagram of the hand is shown below.

In 1933, Hans Bethe left Germany. He accepted a position at Cornell University in 1937 and received the 1967 Nobel Prize in Physics for his discoveries about nuclear reactions in stars.

Another link to Hans Bethe was Dr. Eugene Murphy, Ph.D., also a graduate of Cornell University. Dr. Murphy headed research and development of prostheses for VA after World War II. He and his wife retired to Ithaca and lived in the same building as Hans Bethe.



## NURERC Welcomes Kengo Ohnishi, Ph.D.

**D**r. Kengo Ohnishi arrived at Northwestern University in March from Oita University in Kyushu where he is a Research Associate in the Mechatronics Course, Department of Welfare Engineering, Faculty of Engineering. Dr. Ohnishi's research interests include development of a 3-D cam mechanism for a robotic digit; clinical testing and evaluation of an upper limb rehabilitation system for cervical spinal cord injured patients; and evaluation of structural designs for an anthropomorphic mechanical hand. His recent focus has been on multifunctional robotics and prosthetic hand design and control, rehabilitation and assistive systems. Dr.

Ohnishi has worked to develop a new upper limb prosthesis, Tokyo Denki University hand and Shape Memory Alloy (SMA) controller for arm joints for which he won a Best Paper Award (2003) from the Society of Life Support Technology.

During his one-year tenure at NURERC, he will work together with Richard F. Weir, Ph.D.,

and his team to develop a multifunctional EMG controller for a prosthetic hand. This project is a part of Dr. Weir and his group's project to develop inter-muscular EMG sensors with a fuzzy-logic based

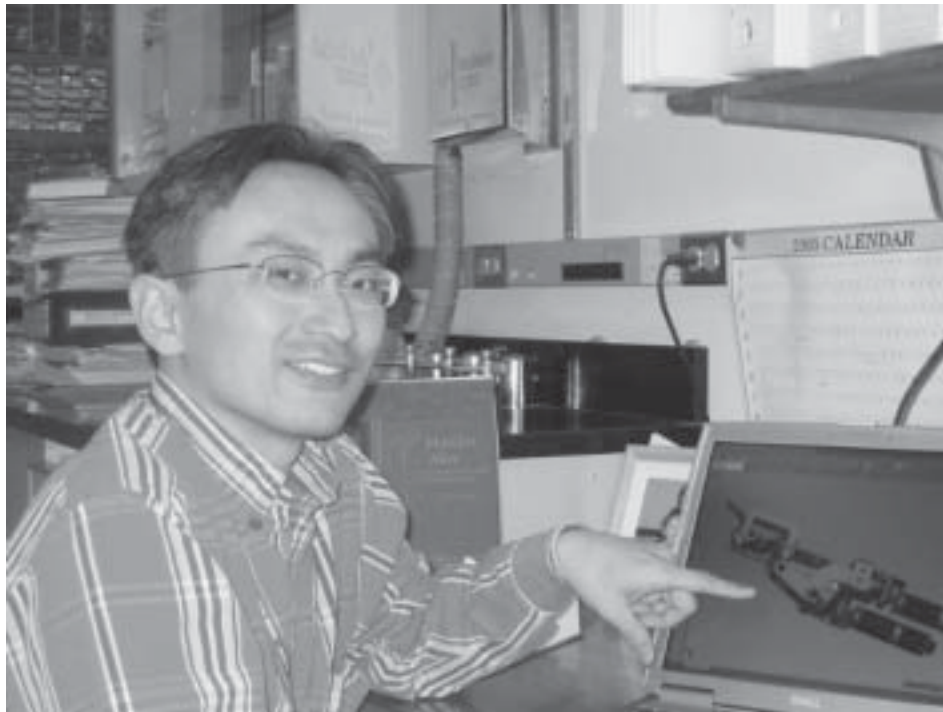
controller for a prosthetic hand with multiple independent joints. In addition, Dr. Ohnishi expects to learn how EMG is applied clinically to the control of upper limb prostheses at RIC.

Dr. Ohnishi graduated from Tokyo Denki University's Graduate School of Science and Engineering where he completed his doctorate (2002) in the Department of Applied Systems Engineering and his M.S. (1998) in the Department of Mechanical Engineering. Also a graduate of Osaka University School of Mechanical Engineering, he completed his B.S. (1996) in the Department of Computer Controlled Mechanical

Systems. He completed an internship (1998-1999) at the Intelligent Robotics Laboratory, Vanderbilt University in Nashville, Tennessee.

Well accustomed to life in the USA, Dr. Ohnishi lived in Illinois during elementary

school. Now, he lives in Wilmette with his wife and their two sons. We welcome him to NURERC and sincerely hope that his work with us will be fruitful and fulfilling.



**Kengo Ohnishi, Ph.D., is a Visiting Researcher at NURERC Laboratory this year.**

# Polio: Endnotes to a Scourge

By R. J. Garrick, Ph.D.

**A**t this time, we take a quiet moment to recall those friends, family and colleagues who experienced the ravages of polio. Particularly here at NURERC, we recall with admiration and affection the important lives and contributions of **Margaret Pfrommer** (1937-1998) and **Jan Little** (1939-2003), both of whom survived polio to live full and independent lives, while actively working for the advancement of rights and technologies for persons with disabilities.

## **Fiftieth Anniversary of the Salk Vaccine**

Fifty years ago, Salk's killed-virus vaccine was the first safe, effective vaccine against polio. It was a milestone in public health and the nation hailed Salk a hero. In 1962, US doctors, officially accepted a live-virus vaccine, the Sabin Oral Polio Vaccine (OPV) as the standard.

## **Eradicating Polio**

Rotary International targeted 2005 as the year to eradicate polio worldwide, but recent outbreaks of polio in Africa and the Middle East and its spread to Indonesia remind us that polio is not a disease of the past. There is no cure for polio; vaccination is the only prevention. Poliovirus is highly contagious, passed by fecal contact through water and food. Prior to improved public sanitation, babies typically contracted polio as an intestinal disease that did not necessarily result in paralysis but rendered a lifelong immunity against the disease. Improved sanitation, sewage disposal and water purification exposed fewer children to the disease during infancy, but put them at risk for paralysis at an older age. Americans who lived during the 1950s and earlier recall poliomyelitis epidemics that struck parents and children alike. Until the advent of Salk's vaccine, polio epidemics persisted in spite of preventive measures, including isolation and quarantine.

Polio often began like influenza with high fever, muscle ache and nausea. Poliovirus attacks the anterior horn cells and reduces muscle strength by destroying nerves, resulting in spinal, bulbar (respiratory) and/or limb paralysis. Patients experienced paralysis that began at the bottom of the nerve system and worked its way up to the cranial nerve. Within hours, experiencing extreme pain, patients were paralyzed

or left unable to breathe or swallow. Often the result was irreversible.

## **Improvements in Assistive Technology**

Although the last report of "wild" polio in the USA occurred in 1979 among unvaccinated Amish, thousands of Americans are polio survivors who now experience post-polio syndrome (PPS). Rehabilitation engineering has been essential in creating improvements in assistive technologies. Respiratory assistance that began with the "iron lung" has evolved through the "rocking bed," the abdominal / chest chamber respirator, and the standard ventilator with tracheal tube. A surgically implanted electric stimulator of phrenic nerve or diaphragm is the newest technology to benefit people who require respiratory assistance.

In the field of orthoses, lightweight plastics and alloys fitted to the limb with locking or swing joints and Velcro strapping have replaced metal braces and leather strapping.

Improvements in wheelchair are legion, including superior design and construction. Better seating material, increased durability and speed, motorized wheelchairs, as well as sip-and-puff controls are among the engineered devices that make everyday activities accessible for polio survivors and others.

## **Jonas Salk, A Hero of Our Time**

In the United States, polio epidemics ceased after the implementation in 1955 of nationwide vaccination programs. Thanks to Jonas Salk and his colleagues, almost overnight the vaccine gave the American populace a lifetime immunity against polio.

*(Visit the National Museum of American History's exhibit, "Whatever Happened to Polio?" on-line at <http://americanhistory.si.edu/polio>)*

# Educational Outreach: Global Village Scientists Visit RIC

On April 17, 2005, as part of Northwestern University's Rehabilitation Engineering Research Center's (NURERC) education and outreach mission, our lab and the Sensory Motor Performance Program (SMPP) were delighted to host a 4<sup>th</sup> grade class from Horace Mann School in Oak Park (District 97).

Since 1991, Oak Park School District 97 has funded the Global Village Scientists program that enables elementary classes in grades 3-8 to visit individual scientists who host hands-on learning experiences in their museums, academic and scientific institutions. For the past nine years, Emily Keshner, Ph.D. (Research Professor and Senior Clinical Research Scientist at the Sensory Motor Performance Program (SMPP), Rehabilitation Institute of Chicago (RIC), Department of Physical Medicine and Rehabilitation, Feinberg School of Medicine, Northwestern University) has arranged for fourth graders from the Horace Mann School to visit RIC.

Before they visit RIC, Dr. Keshner visits the 4<sup>th</sup> grade class to explain how the brain and spinal cord control muscles and movement. The children dissect sheep brains and learn which areas of the brain control which parts of the body. Some children wrote that their favorite part of the program was dissecting the "gross and smelly sheep brains." Dr. Keshner helps the students conduct experiments with automatic reflexes, such as the tendon tap and blink. They also participate in studies

on reaction time, balance, memory, and sample virtual optics and visual plasticity. At SMPP they visit the Virtual Reality and Postural Orientation laboratory with Dr. Keshner.

At NURERC, the 4<sup>th</sup> graders rotated among several learning stations: 1) upper-extremity prosthesis design and development with Craig Heckathorne, M.S.; 2) prosthetic foot fabrication with Andrew Hansen, Ph.D., and Steven Steer; 3) motion analysis laboratory with Stefania Fatone, Ph.D., Rebecca Stine, M.S., Brian Ruhe, M.S., and Po-Fu Su, M.S.



**Figure 1:** Craig Heckathorne, M.S., explains a myoelectric hand control system to 4<sup>th</sup> graders from the Horace Mann School (Oak Park School District 97).

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Excerpts from the students' letters to NURERC and SMPP provided insight to what they learned and enjoyed. Alex wrote, "I'm glad you spent your time with us and taught us more about the Rehabilitation Institute of Chicago." Another student expressed, "All the stations showed something different. I liked them all."

Craig Heckathorne, M.S., explained upper-extremity prostheses to the 4<sup>th</sup> graders who expressed special fascination with the myoelectric hand control system (Figure 1). After using his arm muscles to send electric signals to a prosthetic hand, Spencer wrote, "The best thing in the hand lab was when you got to make the hand move by moving your hand." Sam concurred, "It was so cool because you could move your hand and another one would move." Alex wrote, "It was cool to make the prosthesis hands open and close."

Referring to prosthetic foot fabrication (Figure 2) presented by Andrew Hansen, Ph.D., and Steven



**Figure 2:** Andrew Hansen, Ph.D., explains how to fabricate the Shape&Roll foot.

Steer, Esther wrote, "It was cool to see how they made artificial feet." After learning about the accessible technology used to make the Shape&Roll foot, Spencer wrote, "My favorite thing at the foot lab was pushing the machine (lever) down."

Reflecting on motion analysis (Figure 3) demonstrated by Stefania Fatone, Ph.D., Po-Fu Su, M.S., and Rebecca Stine, M.S., Esther wrote, "I enjoyed the station where you can see how they made some movies and the foot pressure." Brian Ruhe, M.S., a bilateral amputee, helped educate the group



**Figure 3:** (From left to right) Stefania Fatone, Ph.D., Brian Ruhe, M.S., and Po-Fu Su, M.S., explain and demonstrate motion analysis using force plate and infrared cameras.

about lower limb prostheses, gait analysis and the force plate. Pamela seemed to summarize the consensus of the students when she wrote, "Brian was really cool and friendly. I really liked him!"

Margaret wrote, "I learned a lot from you all...I think that you all picked a wonderful job." We agree with her and hope that she or others from her class may enter our field in the future.



## NEWS FROM THE DEPARTMENT OF VETERANS AFFAIRS

### Transitioning Our Returning Soldiers

By  
Robert M. Baum  
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Prosthetics and Sensory Aids Program (113)  
VA Central Office, Washington, D. C.

It's in the news every day: some of our soldiers are getting injured in the war in Iraq. What's not in the news is the care and treatment they receive when they return home. In last quarter's publication, you learned about what Walter Reed Army Medical Center (WRAMC) is doing for those who have lost limbs. However, when they are discharged from the military, they become the responsibility of the VA.

People have asked what is the VA doing for these young veterans? Some have asked whether we could handle the workload, and others have asked if we are capable of providing the same high quality prosthetic appliances as at WRAMC. I attribute these doubts to the fact that the Department of Veterans Affairs (VA) is prohibited from advertising itself. However, my goal in this article is to correct any misperceptions some may have in regard to prosthetic care in the VA.

Using qualified in-house or contract prosthetists, the VA provides new and emerging technologies to our amputee patients. VA always has been a leader in this field and will strive always to maintain that leadership. The Computerized-leg is just one example. Once the FDA approved the C-leg, VA

jumped at the opportunity to study the C-leg in order to determine its benefits. The VA trained its own prosthetists to fabricate them and years ago was the first Federal agency to provide such devices to our patients/customers. It didn't take us long until we were providing them to our veterans. They deserve only the best. In that same vein, years ago, when myoelectric arms were first considered state-of-the-art technology, VA was fitting and providing them to our veterans. Since then, you have seen private insurance and Medicare follow VA's lead.

The prosthetists contracted by WRAMC are in part, some of the same prosthetists who provide services/products to the VA. If an accredited in-house VA prosthetic/orthotic laboratory is not able to fit an appliance, VA will contract out to private prosthetists (based upon the patient's selection). In fact, although each VA medical center has an established multidisciplinary Amputee Clinic team, the majority of artificial limbs prescribed in VA are contracted out. The VA laboratories have existed for nearly 50 years and they continue to provide the best in quality prosthetics and orthotics to our patients.

Can we handle the workload? Unquestionably, yes! On a yearly basis, VA provides more than 10,000 artificial limbs, including some spares and some replacements. Furthermore, annually VA's Prosthetics Department serves over 1.3 million veterans; and our workload continues to climb by at least 15% each year. In any event, with this type of workload, we gain significant experience and access to the latest information and technology available.

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Additionally, VA has defined and is progressing toward implementing an even more comprehensive system of care for amputees. This system of care was developed by the collaboration of professionals in the areas of rehabilitation, prosthetics, and podiatry. The system of care is comprised of four distinct levels of service to meet the needs of persons with amputations as they move through the continuum of care. This system of care is currently in the Veterans Integrated Service Networks (VISN) strategic planning process and will continue to be developed and implemented across all VISNs to ensure that all our amputees will have access to the level of care

required by their impairments. In addition to this, four (4) Polytrauma Centers have been named to provide total healthcare to veteran patients and to Operation Enduring Freedom/Operation Iraqi Freedom soldiers returning with multiple or complex injuries and conditions.

VA has a great track record in caring for our amputee patients and I'm glad I have this forum to let everyone know. Rest assured, VA will always be the leader in this field. Veterans will always get the best in care, service, and technology at VA—not just because we want to provide it, but because veterans deserve it.

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## Long Term Care In Japan

facilities (*rojin hokenshisetsu*); and 3) hospital wards for long term care patients (*kaigo ryoyogata byosho*). Other benefits are home care services for the disabled and group home for the demented. These services include: home helpers, bathing services, visiting nurses, visiting PT/OT, loan of assistive equipment, structural modifications for accessibility at home, equipment for ADLs such as bathing, eating or toilet hygiene, respite care, short term care, day service (ADL-oriented) and day care (medical-rehabilitation oriented). Eligible patients or their family must pay a 10% co-payment. Patients receive no cash payments.

LTCI in Japan is funded in the following way. Half (50%) of LTCI funds come from taxes (25% from the central government, 12.5% from prefectural governments and 12.5% from city governments). Workers and employers pay the other half (50%) through required premia. People older than 65 continue to pay 18%, but those who are between 40-64 years old pay 32%. Employers pay the rest.

### Future Implications for LTCI Systems

Japan has a rapidly aging population with potentially fewer contributors to LTCI and fewer caregivers for elderly, disabled patients. In the U.S.A., only 12% of

the population is 65 years or older. In Japan 17% of the population already is 65 or older; it is projected to be 25% by 2015 and 33% by 2030. The United States has slightly more time to adjust, but it is only a matter of time before we are faced with a similar situation.

Japan designed its LTCI system to benefit the disabled elderly, but within a year, LTCI patients and expenditures increased dramatically. At first, LTCI spending was \$3.6 billion but now it exceeds \$6.3 billion. Within five years, LTCI expenses are predicted to be \$6.8 billion. In 2005, the Japanese Diet passed a law to reduce spending and to expand special funds for preventive measures directed at the Preliminary Classification (*yoshien*). Forced by economic exigencies, the Ministry of Health and Welfare and Labor expects major financial reductions in 2006.

The United States has private, elective LTCI corporations, but the premia are prohibitively costly for most people and the percentage of the U.S. population that can pay for LTCI is extremely low. Usually employers do not contribute. It is predicted that a 3-year stay in a nursing home will cost upwards of \$200,000. Better care and longer survival mean greater expense. How and who can pay this expense? Will individuals, taxpayers or employers support this national need? Similar to Japan, the U.S.A. faces an ever-increasing aging population that presents significant challenges to Social Security, Medicare, Medicaid and long term care insurance systems.

# Long Term Care in Japan

By

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and

R. J. Garrick, Ph.D.

## A Visit to Hatano Clinic

This spring, while studying a variety of rehabilitation settings in Japan, we visited Hatano Clinic in Hiroshima. Established by Dr. Eiji Hatano, a physiatrist who has practiced rehabilitation medicine for 30 years, this medical complex provides a full-spectrum rehabilitation service: in-patient, outpatient, respite care, short-term stay, and a home for various levels of dementia. Central and integral to treatment goals at Hatano Clinic is normalization of the lives of people with disability, including those who are profoundly disabled. Hatano Clinic owns a fleet of tiny vehicles (Figure 1) and employs approximately 200 staff who provide the patients with home care and transportation to and from the Clinic.

We were honored to accompany Dr. Hatano through his workday, beginning with morning house calls to four severely disabled patients. Dr. Hatano's considerate interactions with his staff, patients and their families was a primer for good bedside manner. Furthermore, his extensive practice experience gave us important insights into how Japan's mandatory national long-term care insurance (LTCI) system works.

## House Calls

Tossing a well-worn Nikon camera bag into the back of his 650cc hatchback and elegantly folding his tall frame into the tiny car, Dr. Hatano drove quickly over impossibly narrow, winding roads. He explained that on house calls, he always strives to preserve the normalcy of his patients; he never wears a white lab coat and his weathered camera bag camouflages his medical equipment.

During morning rounds, we visited 1) Mr. A, a man with tetraplegia who lives with his parents; 2) Mrs. B, a woman with tetraplegia who lives at home with her

husband; 3) Mrs. C, a widowed woman who is oxygen dependent with congestive heart failure and emphysema who lives with her married son and his family; and 4) Mrs. D, a widowed woman who is blind with osteoporosis, spinal fracture and lives alone. Prior to Dr. Hatano's arrival, nurses and health aides from Hatano Clinic already had arrived at the patients' homes where they attended to toileting, bathing and feeding the patients. By the time the doctor arrived, they had prepared each patient for examination and completed their medical notes.

## LTCI for Japan's Severely Disabled

Let us consider Mr. A, a 56-year old man who in 1987 experienced a severe stroke resulting in tetraplegia. He spent 12 years in a hospital where his parents, now aged 80 and 86 years old, visited him almost daily. The patient has a smile reflex and no



**Figure 1:** Cars (650cc) provide transportation to and from rehabilitation and medical care at Hatano Clinic.

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verbal response. His extremities are rigid, arms flexed and legs extended. He has seizure activity and a ventriculo-peritoneal shunt for hydrocephalus. His swallow reflex is absent and he requires gastric tube feeding. He wears a Foley catheter for bladder and diaper for bowel incontinence. During his stay in the hospital, he developed extensive pressure sores on his back and heels that required surgery.

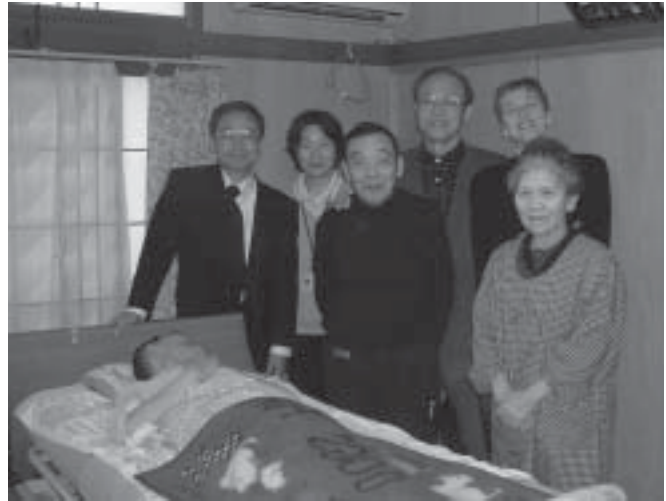
### How to Live at Home with Tetraplegia

After the implementation of Japan's LTCI law, Mr. A's parents sought LTCI benefits for him. The LTCI office at city hall told them that they could care for Mr. A at home, based on a doctor's documentation of his medical condition and his evaluation by a "care manager." The application and approval process took one month. LTCI approved Mr. A's return home with the support of: 1) care workers who visit daily in morning and evening; 2) a visiting nurse every other day; 3) a visiting doctor once per week; and 4) day care attendance twice per week.

Now, with the support provided by his parents and Japan's LTCI, this man with tetraplegia has returned to live at home (Figure 2). Mr. A's parents expressed a Japanese belief that people are happier to be cared for at home than in a hospital, and proudly showed that Mr. A has no pressure sores. They emphasized that LTCI allows them to care better for their son at home than if he were in an institution. If Mr. A still lived in a hospital, medical insurance would pay \$5500 per month for his care. But, now that Mr. A is covered by LTCI, is classified as having the severest level of disability and lives at home, his classification renders his medical care free, including a waiver of the usual 10% co-payment.

### Overview of Japanese LTCI

Let us consider some major features of Japan's LTCI that support this level of normalization in the lives of severely disabled, usually elderly people. In 2000, after studying the German LTCI system, Japan launched its own mandatory, national LTCI that replaced welfare and medical care for the elderly. People who are 65 and older are eligible for LTCI coverage. Those who are aged 40-64 are eligible only if afflicted by any of fifteen age-related diseases. Problematically, eligibility



**Figure 2:** Mr. A at home (foreground). Standing (left to right) Michael K. Yoshida, M.D., a staff member from Hatano Clinic, Mr. A's father, Eiji Hatano, M.D., R. J. Garrick, Ph.D., and Mr. A's mother.

in Japan's LTCI does not provide for disabled individuals who are younger.

Japan's LTCI system provides support for 6 levels of disability, based on the number of care hours required per patient. A Preliminary Classification (*yoshien*) consists of patients who require preventive, supportive measures, such as muscle strengthening exercises, in order to avoid exacerbation of their condition into Level One. Initially, a physician documents a patient's medical condition and submits it to a municipal committee comprised typically of 2 medical doctors, a nurse, a social worker and a city officer who monitors use of funds. This committee bases its final decision on: 1) doctor's opinion about the patient's medical condition; 2) data from a home visit; and 3) a computerized assessment consisting of 85 items that evaluate the patient's functional Activities of Daily Living (ADL), as well as his/her physical, cognitive and mental condition. The committee places patients in Preliminary Classification or Level 1 (requiring fewest hours of care) through Level 5 (requiring most hours of care). Next, the care manager (in U.S.A. the "care coordinator") creates the total care plan and submits it to the city.

LTCI benefits can provide institutional care: 1) permanent resident nursing homes for the severely disabled elderly (*tokuyo*); 2) intermediate care living

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