Eat, Sleep, Click: The Bicycle-Powered Internet

by Jane Anne Morris

Save a tree, bank online. Subscribe online, reduce your carbon footprint. Listen to music online, watch movies online, read books online. No mess, no fuss. Google Inc. has photovoltaic (PV) solar panels on its headquarters. With all that footprint-lightening, you may soon be down to no ecological footprint at all, right?

Since everyone wants the Internet to have a gentle footprint and not be "evil," we should power it with green electricity. Start with a bicycle generator and a server. Here are some back-of-the-envelope figures.

All the stuff on the Internet, or in the "cloud," is kept aloft by computers called servers (plus routers and so on). An average server draws 400 watts/hour, half of that for cooling (fairly typical), and 3500 kilowatt-hours (kWh) per year, [1] because it never shuts down.

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A healthy biker can produce a constant 100 watts/hour on a bicycle generator, a generous estimate. Four generator bikes at 100 watts/hour apiece would power a server. Alas, that single server can't accomplish much by itself. Various techies have estimated that a single online search activates between 1000 and 20,000 servers, often located all over the world.

Numerous servers are housed together in places called server farms or data centers. To power a modest-sized data center (50,000 servers) by bicycle power would require almost a million pedalers and an area equivalent to 347 football fields. [2] Data centers can be as small as closets at the back of a business, or as large as several football fields and use as much electricity as small cities. They run 24/7/365, and tend to have multiply redundant backup systems, so no one has to wait 10 seconds to learn from a web site if it's raining outside.

> ## Data centers … use as much electricity as small cities.

What finally matters is not this or that server or data center, but the overall Internet electricity use. How much bicycle power would it take to run the Internet? Later we can figure out how to landscape the facility, and decide where to put the snack bars and port-a-potties.

The EPA's conservative and dated number for 2006 Internet electricity use within the US alone is 60 billion kWh. Getting that much electricity from the setup described above would require 600 million bike generators. Assuming 6-hour pedaling shifts, that would take 2.4 billion pedalers. Think of the stimulus to the global economy: pedaling jobs for the entire populations of the US (305 million), Canada (33 million), Mexico (110 million), South America (382 million), India (1.5 billion), and Japan (127 million).

Five years later, that number has doubled (at least). It is widely claimed that in 2010 the Internet used 3% of US electricity (3884 billion kWh), which is 117 billion kWh. So, we're now talking about 1.2 billion bike generators and 4.8 billion pedalers.

In 2007, an independent outsider who is not on the dole of the IT industry calculated that US Internet energy use was around 350 billion kWh annually, approximately six times the EPA's 2006 estimate, [3] and three times the conservative 2010 estimate used above. I will use the lower numbers, but actual Internet electricity use may be much higher.

What about worldwide Internet electricity use? Available 2010 estimates—200 billion kWh [4] — are probably conservative. What's that in bicycles?

Using the same assumptions as before, that worldwide Internet could be powered by a mere two billion bike generators, with 8 billion people pedaling. (Current world (over)population is 7 billion.) If you placed that many bicycles end-to-end, they would reach far enough for three round trips to the moon, and then a trip back up.

Who would want to design a bicycle-generator system to power the Internet? Someone who wanted to imagine a human-scale equivalent for how much energy the Internet already sucks up. What about other "renewable" energy sources?

Solar and wind-powered Internet

At the biggest, most successful photovoltaic projects in the world, the rule of thumb is that 10 acres of panels produces a megawatt of capacity (as would 10,000 bicycle generators). A square mile (640 acres) could provide 64 MW. Each megawatt might yield 1.5 million kWh/year, so the annual

kWh from a square mile of good solar would be 96 million.

Generating an annual 117 billion kWh (2010 US Internet use) with solar would require at least 1220 square miles of PV panels, and 78,000 MW. [5] For the 200 billion kWh number for world Internet use, it would take 2081 square miles (that's Delaware) and 133,200 MW.

What about a wind-powered Internet? Experience in the wind turbine industry (and again in the

Generating … US Internet use with solar would require at least 1220 square miles of PV panels…

choicest spots), has shown that it's good to get 20 MW of capacity per square mile. Three million kWh a year from each megawatt of capacity is also optimistic.

Using wind turbines to get that 117 billion kWh for 2010 US Internet electricity use would require 1950 square miles. [6] The 200 billion kWh for 2010 world Internet use would require 3300 square miles. Most wind power sites are less productive than the sites from which these numbers were derived.

It's not appropriate to compare solar and wind directly to conventional power plants. Except for maintenance and accidents, coal and nuke plants operate 24/7, though demand drops at night. In contrast, solar is always down at night, and wind is variable, exactly what data centers can't be.

With solar, more than half the electricity would have to be stored for use when little or no power is generated. The huge batteries necessary for storing this much power look like a cross between upturned railroad freight cars and electric substations. They require space, maintenance, and cooling. Every time energy is converted from one form to another (like rotating energy to electrical energy to heat energy, or electricity into batteries and then out again) energy is lost. That slippage increases the initial kWh necessary, but I have not factored that in.

Also omitted in calculations here are the power lines, substations, maintenance roads, other support facilities, and ladders and buckets of ammonia water to clean PV panels. Not to mention the fact that most areas don't get nearly as much sun as the prize spots already selected for large solar arrays. I'm also not considering the resources needed to manufacture, transport, and main-

Megawhat?

A solar panel rated at one kilowatt of capacity will produce one kilowatt-hour of energy if the sun shines on it steadily for an hour. Terms like megawatt, kilowatt, and watt express power or capacity, while megawatt-hour, kilowatt-hour, and watt-hour measure energy. A kilowatt is a thousand watts; a megawatt is a million watts or a thousand kilowatts.

tain the PV panels. Similar considerations apply to wind power.

Solar and wind have different advantages. Fewer acres of solar than wind are required for each MW of capacity (10 versus 32), but for each MW capacity of wind, you get more kWh/year (3 million as compared to 1.5 million). That is because you are never, ever, going to average more than 12 hours daily of solar. However, you might average more than that for wind, depending on location and circumstances.

At the scale necessary to power data centers, solar, wind, and even bicycle power involve considerable habitat loss. Bicycle space to power the 2010 US Internet would be about 4304 square miles (about the size of the Everglades). For the 2010 world Internet, about the combined area of Delaware and Connecticut. When chunks of ecosystem are shoveled into industrialism's mill, Gaia is diminished. Acres sacrificed to solar arrays, wind farms, power line rights of way, or thousands of bicycle generator pads destroy habitat no less than those given over to GMO crops, cooling ponds, interstate highways, and parking lots.

Energy-intensive, thy name is Internet

How can the Internet use so much electricity? Suppose you have an awesome video of your cat at a laptop using her little cat feet to scroll through online celebrity cats in fetching poses. (Click for full screen.) It's stored in your email account, and you have a copy on your laptop and/or handheld. Your email is backed up by the company that offers it, and you have backup service for your laptop, so that's more Internet storage space on servers somewhere; then the back-up companies back up their back-ups. You send the cat video to 50 people. Some store it in their emails; some download it and have it backed

Your email is backed up by the company that offers it, and you have backup service for your laptop…

up on their own online backup systems; some send it out to a few other people; and some do all three. How many places can we find the cat? It's a hall of mirrors, a grain of wheat doubling on each square of a chessboard. All of it eats kilowatt-hours. How much fracking is that cat porn worth to you?

All online content is not born equal. It takes very little electricity to support text, even italics. Graphics such as photos and drawings are much more energy-intensive. Music exceeds even graphics, and video (bouncing bunnies, or time-lapse wrinkle cream results) is the greediest of all.

Online action is hosted and processed in massive data centers that use up to 100 or even 200 MW of demand; data center operators are not often eager to release this information. Chicago's Lakeside Technology Center (a data center) reportedly draws 100 MW, a higher electric demand than any other

Commonwealth Edison customer except O'Hare airport. A quick check reveals what a "renewable" electricity supply would look like for a facility like this. With bike generators: over a million generators, over four million pedalers, and almost half a million acres, which is 757 square miles (almost three times the size of Chicago). Probably not available anywhere near the Loop. Using solar panels: 2917 acres (2210 football fields), not counting battery space, which is also probably not in the Chicago zoning plan. Using wind in the "windy city": 9347 acres (or 7081 football fields), again not counting battery space.

As Alex Roslin of the *Montreal Gazette* put it, if the Internet were a country, it would be the fifth biggest power consumer, ahead of India & Germany. [7]

Who is paying for this?

Tax breaks and other subsidies are common for data centers. Even modest-sized ones often reap government subsidies for drawing huge amounts of electricity and providing fewer jobs per buck, or per kWh, than almost any other kind of facility.

For instance, in 2007 a Google Inc. data center got tax breaks on utility bills, plus a property tax exemption. Iowa's own web site describes the tax exemption as including "cooling systems, cooling towers, and other temperature control infrastruc-

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ture....also exempt from property tax are all power infrastructure for transformation, distribution, or management of electricity used for the maintenance and operation of the web search portal, including but not limited to exterior dedicated business owned substations, back-up power generation systems, battery systems, and related infrastructure; and racking systems, cabling, and trays, which are necessary for the maintenance and operation of the web search portal."

Iowa even calculated its expected tax losses: $3.6 million in 2009, $12.7 million in 2010, $22 million in 2011, and $32.7 million in 2012. The corporation got a similar deal in North Carolina, where estimates of tax losses to the state were approximately $97 million over 30 years.

Lack of enforcement of environmental and occupational safety laws across the board is an often-overlooked form of subsidy available to large corporations, including data centers. This includes the cradle-to-grave production, processing, transport, and use of nuclear and fossil fuels, as well as the toxic waste and byproducts of same. Companies burn through energy and resources far more cheaply than would be possible if laws "on the books" were enforced.

Finally, there are those bargain-basement electricity bills. Data center electricity rates are as low as 3–4¢/kWh, while residential customers pay much higher rates: easily 15, 20, 25¢/kWh, and even steeper when charges for distribution and other fees are included. [8]

The public is massively subsidizing data centers, the Internet, and the profits of IT corporations.

The public is massively subsidizing data centers, the Internet, and the profits of IT corporations. Yet, many corporations with huge data centers are not eager to advertise their locations, and use third parties to negotiate their deals. Some go to great lengths to hide their electricity use. In 2007, for example, at Google Inc.'s urging, Oklahoma rewrote its open records law to allow data center owners to conceal from the public the amount of electricity used.

If inefficiency is not the problem, efficiency is not the solution

When I raise the issue of the massive electricity use of all things Internet, everyone tells me how efficient IT is becoming.

The idea that efficiency reduces consumption is at best debatable, and at worst a public relations scam. As Don Fitz wrote in "Why Energy Efficiency Isn't Reducing Consumption" (*Synthesis/Regeneration* 50:30, 2009), over a century and a half of research on the relationship between efficiency and consumption of a resource has marshaled considerable evidence that the opposite is true. Since Stanley Jevons documented that coal consumption increased 10-fold after smelters tripled their efficiency (*The Coal Question*, 1865), the phenomenon has been called the Jevons Paradox. Historically, in capitalist systems, increased efficiency has led to more consumption, not less.

Being efficient is good, but it does not mean sustainable, it does not mean green, and it does not portend reduced consumption. Data center efficiency is improving, and Google Inc.'s are reputed to be among the best. But when Gaia is diminished by the ripping out of coal and the dumping of sludge, her suffering is in no way reduced if the resulting electricity is used "efficiently." Earth's problem is not the inefficiency of resource use, but the quantity. Ask Gaia.

Food, internet, spam

Why do we figure out the ecological implications of eating a hamburger but not clicking a search? When it comes to food, the green or even greenish band of the political spectrum is all over it. Local food. Organic food. Slow food. Urban agriculture. Permaculture. Rooftop gardens. Alice Waters, Will Allen, Michael Pollan. "Eat food. Not too much. Mostly plants." Fast food nation. Eat low on the food chain.

But when it comes to the Internet, people spout shallow unexamined cliches as they tap at sleek,

shiny gadgets. The PV panels at Google Inc.'s headquarters and other cheap stunts deflect attention from the enormity of Internet energy use. Engineering Professor Mohamed Cheriet, at Montreal's Ecole de Technologie Superieure, who works on "green" IT innovation, gushes, "We've found the key to the problem: Follow the wind, follow the sun." [9] The Internet is the fast food triple bacon cheeseburger of communications, yet people are convinced it's green.

Are the brains who figured out it takes 150 or 630 or 1300 gallons of water to produce a hamburger just out to lunch when it comes to the Internet? Why is the Internet—a global system if there ever was one—immune from the same analysis?

…one single spam campaign generated three emails for each person on the planet…

Spending two hours on the porch showing your neighbor your family photo album is not especially energy-intensive. Doing so online, and sending it around to everyone on your email list, carries vastly higher ecological costs.

What's the actual content that billions of publicly subsidized kWh go to support? Nicholas Carr (*The Big Switch*, 2008) estimated in 1996 that 94% of all emails are spam, and that there may be 85 billion spams a day. This year, John Markoff in the *New York Times* claimed that about 90% of all email is still spam, and that one single spam campaign generated three emails for each person on the planet, some 21 billion messages. Ken Auletta (*Googled*, 2009) suggested that as many as a quarter of all searches are for porn. According to Alex Roslin at the *Montreal Gazette,* 250 billion emails are sent daily. [10] The study Markoff referenced suggested that over 12 million messages were needed to sell $100 of Viagra. [11] Dennis Walsh from green@work, among others, states that over 200 million Internet searches happen daily in the US alone; 100 million photos are uploaded daily. Google Inc. has reported that it carries out about a billion searches per day, according to James Glanz in the *New York Times*. [12]

One person estimated that fantasy football aficionados spent 2.4 billion hours online per season. [13] Online games, role-playing, social networking, gambling, and an almost unbelievable amount of advertising are up there in the "cloud" at tremendous energy cost. Much of it is not the relatively energy-cheap text, but the photos, music, video, bouncing cartoons, and interactive click-fests that are hundreds or thousands of times more energy-intensive. Subsidizing the entire current Internet system because an activist can upload photos of stripmining and clearcutting is like subsidizing an industrial-sized Wal-Mart because six feet of shelf space holds organic spinach.

The Internet is not, and will not be, powered by so-called renewable energy, magical energy that is somehow without consequences. Sleek, glowing screens may hide the truth from people who don't want to hear about it, but the consequences remain. The real costs of Internet electricity use are being cast over state boundaries and national borders, across class, ethnic, and species lines, and onto future generations.

In hindsight, most wish that we had used a little more foresight about the automobile. Today is a good time to look up from our screens and take advantage of the fact that we are still in the Model T era of the Internet.

If we keep pretending that the Internet is innocuous, neutral, democratic, clean, and green, we can look forward to more iPipelines, iFracking, iMountaintop Removal, iCoal Plants, iNukes, iStripmining, iSpecies Extinction, iHabitat Loss, iClimate Change, iTar Sands, iSludge, iOil spills, iFloods, and continued iResource Wars.

Or, we can begin to give it the attention we give a burger.

Corporate anthropologist Jane Anne Morris (democracythemepark.org), whose most recent book is *Gaveling Down the Rabble: How "Free Trade" is Stealing Our Democracy* (Apex/Rowman & Littlefield, 2008), first wrote about Internet energy use in "The Energy Nightmare of Web Server Farms: Feet in the Cloud, Head in the Sand," *Synthesis/Regeneration*: A Magazine of Green Social Thought, Winter 2008 (www.greens.org/s-r/45/45-03.html).

Notes

1. 400 watts/server, for 8760 hours, would be 3,504,000 watt hours, or 3500 kWh a year necessary for one server.
2. Assume 4 pedalers (6-hour shifts) for each bike generator. 57,600 sq. ft in a football field, or 1.32 acres, including end zones. 43,560 feet per acre. 20,000,000 divided by 57,600 is 200,000 divided by 576 which is 347.22 or 347 football fields. In acres it is 459.136. (200,000 generators, 800,000 pedalers, twenty million square feet).
3. David Sarokin, untitled blog answer, Sat. Aug. 18, 2007, estimating "electricity consumption for the Internet," with assumptions and discussion. This same DS estimated world usage at that time as 868 billion kWh/year. Sarokin data includes pc's, modems, etc.
4. Rich Miller, Google's Energy Story: High Efficiency, Huge Scale, September 8, 2011, Data Center Knowledge website datacenterknowledge.com, quoting a report by Jon Koomey, whose estimate for 2010 was 198.8 billion kWh, worldwide, for Internet use. I rounded that to 200 billion kWh.
5. I looked up the major solar PV projects in the world and took a rough average. 117 billion kWh divided by

96 million per square mile yields the number of square miles =1218.75 = 1219 square miles; 117 billion divided by 1.5 million kWh/yr yields number of megawatts = 78,000 MW.

6. I looked up the major wind projects in the world and took a rough average. 20 MW per sq. mile, 3 million kWh per MW, so 60 million kWh per sq mile, so would need 117 divided by 60 = 1950 square miles.

7. Alex Roslin (*Postmedia News*), Could the Net be killing the planet one web search at a time? in the *Montreal Gazette*, June 3, 2011.

8. One source for this is Ron Starner, Is Energy Still Oklahoma's Trump Card? *Site Selection Online*, July 2007.

9. Alex Roslin, Dirty Data: The Internet's Giant Carbon Footprint, June 4, 2011, *Montreal Gazette*.

10. Alex Roslin (*Postmedia News*), Could the Net... *Montreal Gazette* June 3, 2011.

11. John Markoff, Study Sees Way to Win Spam Fight, *NYT* , May 20, 2011.

12. James Glanz, Google Details, and Defends, Its Use of Electricity, *NYT*, Sept. 9, 2011.

13. www.joulex.net/Green_IT_Blog/bid/58292/

The New Global Medicine

by Don Fitz

Cuba is remaking medicine in a remarkable diversity of cultures in Latin America, the Caribbean, Africa, Asia and Pacific Islands. Its efforts go far beyond providing medical care to other parts of the world as a Western approach might limit itself to doing. The Cuban project includes rethinking, redesigning and recreating medicine in a way that meets the needs of the world's poor.

John Kirk and Michael Erisman provide the most comprehensive documentation of the extent of this undertaking. [1] Since 1961, over 124,000 health professionals have worked in over 154 countries. When they wrote in 2009, 24% of Cuba's 70,000 doctors were participants in health care "brigades" on international "missions."

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Though the majority of Cuban doctors go to this hemisphere and Africa, they have provided relief to the Ukraine after the 1986 Chernobyl meltdown, Sri Lanka following the 2004 tsunami, and Pakistan after its 2005 earthquake. Cuba is establishing medical agreements with Laos, Kiribati, the Solomon Islands, Papua New Guinea, Vanuatu and Tuvalu. By 2008, Cubans were providing medical care for over 70 million people in addition to its own 11 million. Kirk and Erisman conclude that "almost 2 million people throughout the world, many of whom were probably children when they received help, owe their very lives to the availability of Cuban medical services." [2]

Venezuela has developed closer ties with Cuba than any other country and has received the most help from it. According to Brouwer's (2011) *Revolutionary Doctors,* over 14,000 Cuban doctors had come to Venezuela by 2009. Brouwer goes beyond documenting the quantity of help that Cuba provides with his deep insights into social relationships that underlie medicine in both countries. [3]

As in Cuba, the Venezuelan *Barrio Adentro* (inside the neighborhood) program is based on doctor-nurse teams living in the neighborhoods they serve. The closeness of physicians to patients is critical for understanding problems that can afflict a community as well as individual illnesses. Brouwer describes how Cuban Dr. Thomasa discovered why women in the Venezuelan community of Monte Carmelo had more respiratory problems than men, even though they smoked less than them. Trained to peer into environmental and social causes of disease, she realized the cause was "the smoke from wood fires that women still used for cooking, often in closed rooms with low ceilings and no chimneys…" [4]

The success of family doctors living in neighborhoods can only be realized if they are part of a larger system of (a) clinics which serve a wider area with health care specialists; and (b) hospitals and long-term care facilities. Sharing the Cuban view that improved medical care must occur as part of uplifting people from poverty and illiteracy, the Venezuelans established educational programs such as *Misión Sucre*. Cubans and Venezuelans likewise agree that the foundation of a new medical system is providing opportunities to thousands of students who are eager to devote their lives to improving the care of those who need it the most.

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This task is not without resistance. Brouwer explains the indifference of graduates from traditional medical schools as well as the hostility of the Venezuelan Medical Federation. As *Barrio Adentro* unfolded, it was in direct conflict with the old medical system which focused on delivery of health care needs to the better off. Right-wingers fueled a hate campaign, even encouraging violence against Cuban doctors. This reached a head in Barcelona, capital of

the state of Anzoátegui. In 2003, the anti-Chavez local government sent police to shut down a clinic staffed with Cubans. But 300 residents quickly showed up to support the clinic, which remained open. [5]

Just as damaging as acts of violence were the overlapping medical structures, each with an entrenched bureaucracy, which the new medical model needed to break up and replace. In order to ensure that they receive health care, Venezuelans have been active participants in building and defending their new medical system.

To date, Venezuela is the only country which has sought to replicate the Cuban model on a national scale. This article explores events in three countries which show the strengths and contradictions of Cuban participation in world medicine:

Three years later people were still suffering effects of the earthquake.

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1. After its emergency response to the 2007 earthquake in Peru, Cuban doctors set up *consultorios* and a *policlínico* based on the Cuban model, but the road was not smooth.
2. During relief efforts following the 2010 earthquake in Haiti, Haitian patients developed very different relationships with Cuban doctors that they did with those from the US.
3. African and African American medical students in Havana plan to use the knowledge they have gained of Ghana's health problems for a trip which aims to blend Cuban medical approaches into traditional Ghanaian healing practices.

A *policlínico* and *consultorio* in Pisco, Peru

On August 15, 2007, my daughter Rebecca Fitz and Ivan Angulo Torres were vacationing in Arequipa, Peru. She woke up with a bad feeling, which she thinks could have been a health issue or could have been a premonition that at 6:40 that evening a level 8 earthquake would hit the town of Pisco in Ica province of Peru. She went back to Lima, but Ivan had just completed his fourth year at the Latin American School of Medicine in Havana (ELAM, *Escuela Latinoamericana de Medicina,*) and went to Pisco to see how he could help. [6]

Soon, reports would show that over 500 Peruvians died, 1042 were injured and over 100,000 were left homeless. [7] The first international relief to arrive was the Henry Reeve Brigade from Cuba. Cuba's first response teams for international disasters are named after Reeve, an American who joined the Cuban fight for independence and was killed in battle in 1876 after becoming a brigadier general. [8] The Brigades come complete with medical equipment including autoclaves for sterilization and tents for examinations and surgery. Each Henry Reeve Brigade ar-

rives with its own food and water so local resources can go to disaster victims.

Finding the Cuban doctors well-organized to deal with the disaster, Ivan and other ELAM medical students devoted themselves to documenting the Brigade's work. The resulting 12 ½ minute movie, *Nuestra Misión* (Our Mission), shows remnants of the poorly constructed homes which crumbled from the quake and the makeshift thatched homes that replaced them. Many initial injuries were followed within a week by pneumonia deaths from the cold weather. The movie also shows the emergency tent hospital of the Cuban doctors who did 1980 operations, 30,734 diagnostic tests and 151,454 therapeutic treatments. Help only arrived from the Peruvian government when press cameras were rolling. [9]

As the response to the earthquake subsided, the Cuban doctors transformed the emergency tent hospital into the Pisco *policlínico* which has medical exam rooms, a birthing room, afterbirth room, and outpatient operating and recovery rooms. By far, the rooms most in demand at the *policlínico* are for adult and child physical therapy. Three years later people were still suffering effects of the earthquake. When I visited the Pisco *policlínico* in 2010, its director, Leopoldo García Mejias, explained that then-President Ana García did not want any more Cuban doctors coming after the quake and that they had to keep quiet in order to stay in Peru. As is typical for Cuban medical directors, Leopoldo has multiple international experiences, his first being in Honduras after Hurricane Mitch in 1998. [10]

Unlike in Cuba, health care at the *policlínico* is not free. It collects about 80,000 *soles* per year from patients, which it turns over to the Peruvian government for improvements. (One *sol* equals about 36 cents US.) But the improvements were not always forthcoming, forcing the clinic to confront the Alan García administration. By 2010, everyone knew that 200 or so Cuban doctors were in Peru, making it possible for the *policlínico* to garner public support for its needs. Clearly, sustaining a health center is as much a political as a medical happening.

Backing is also likely to come from Peruvians who visit a neighborhood *consultorio.* Peruvian doctors trained in Cuba have set up three *consultorios* in Pisco, each with assistance from a nurse

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The *consultorio* must work within the framework of limited potential for reimbursement while attempting to see everyone …

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completing the last year of nursing school. Dr. Johnny Carrillo Prada and Dr. María Concepción Paredes Huacoto help set up the Consultorio No. 2 in Pisco. They are Peruvians who received medical degrees in Cuba. [11]

Johnny and María explained that the Peruvian health care system is not socialized medicine. For those who work, Peruvian social security takes money out of their paycheck for national health care,

with limitations such as covering only two visits per month and only covering the "primary" illness for those with multiple health problems. The SIS (*Seguro Integral de Salud*, or Integral Health Insurance) provides insurance for the poor, and provides even less coverage.

The *consultorio* must work within the framework of limited potential for reimbursement while attempting to see everyone who comes through the door. Consultorio No. 2 serves about 180 families which each pay one sol per month.

This makes it difficult to bring the model to a country where many cannot read and write.

The backbone of the Cuban system of *medicina general integral* (MGI, comprehensive general medicine) is preventive community health care, with the *consultorio* as its building block. The doctor-nurse team live at (or near) the *consultorio* where they work, meaning that they are part of the community and know their patients well. Cuban *policlínicos* assist 30–40 *consultorios* by providing services during off-hours and offering a wide variety of specialists. They coordinate community health programs and are a conduit between nationally designed health initiatives and their local implementation. In contrast, the Pisco *policlínico* provides a much smaller array of services than would one in Cuba, not only because it has a smaller staff and is linking fewer *consultorios*, but also because it is not part of a network implementing policies designed for free health care.

There are other challenges to applying a MGI model in Peru. Cuban-trained doctors make home visits to everyone in the *consultorio* area. But in low income areas of Peru, the only official-looking persons to come to the front door are cops. So, medical staff had to get to know patients while explaining the central role of home visits.

Since the county is rife with scam artists, Peruvians were skeptical of a *consultorio* providing almost-free anything, especially something as vital as medical care. In order to establish rapport with the neighborhood, the doctors had to work through community contacts such as businesses and schools where they could distribute health materials and provide physical exams.

Perhaps the largest challenge has been education. Following in the footsteps of Che Guevara, the Cuban revolution saw equality in employment, income, education and medical care as proceeding together. Thus, Cuban medical accomplishments are based on wiping out illiteracy. This makes it difficult to bring the model to a country where many cannot read and write.

One problem that Cuban-trained doctors have not had in Peru is a highly mobile population. In the US, poverty often accompanies moving from home to home, which would make it very difficult to apply

a model which assumes the doctor personally knows everyone in the community. In Pisco, however, even the poor tend to stay in the same home. This means that the *consultorio* doctors can know their patients.

When Cuban doctors prepare to join a health brigade to another country, a critical part of their training is learning to respect its culture and not attempting to impose their social values. Without this approach, Cuban medical efforts in Peru never would have succeeded. When in Cuba, a Cuban doctor obviously does not have to think being in another culture. But when part of an international brigade, the Cuban doctor has to simultaneously practice medicine and adapt to that society.

The Alan García government, in power from before the earthquake through the first half of 2011, would merely tolerate Cuban medical efforts. A few days before being sworn in as the new President of Peru, Ollanta Humala visited Cuban leaders in Havana. During his July 28, 2011 inauguration, Humala pledged to eliminate "exclusion and poverty," which suggests closer collaboration between Cuban and Peruvian medical systems. [12]

Disaster in Haiti

When Joanna Souers was 19, she decided that she would work with people who were down on their luck, a decision that would take her to Puerto Rico, Tanzania, Peru, Costa Rica, Mexico, Cuba and Haiti. [13] After graduating with a major in pre-med in 2005, she decided to take time off from school and went to Nicaragua to work on developing sustainable agriculture with Project Bona Fide. She was on Ometepe Island, which mostly grew export crops like rice and coffee, leaving people without a sustainable diet. [14] Joanna saw Nicaraguans who could not be treated by Western medicine because it is too expensive and/or inaccessible. People were

The Cuban doctors walked the same roads and smelled the same smells of injury and death as did Haitians.

more likely to use traditional medicine like mango leaves for swollen joints and manzania or chamomile in baths for fevers or coughs.

After Hurricane Katrina hit New Orleans on December 29, 2005, Joanna went there and joined Common Ground Relief efforts in a nursing center doing support work for direct-care providers. It left a lasting impression on her to know that there were hundreds of Cuban doctors waiting for a nod from the US government, but that thousands of New Orleans residents were deprived of health treatment due to US politics. She realized that Cuban doctors would have made an enormous difference in people's lives. She also realized that most of the aid went to the wealthier areas of the city were the storm caused little damage. [15]

In 2006, Joanna applied to go to medical school at ELAM. She began her studies in 2007 and had

just finished the first semester of her third year when Haiti was devastated by an earthquake on January 12, 2010. The Haitian government put the death toll at over 300,000. An estimated 3 million people were injured or homeless. [16]

Joanna took a semester off to work in the Croix du Boquet field hospital about 11 miles from Port-au-Prince. The hospital had been founded by the Henry Reeve Brigade in the central park of the city. She observed 30–40 surgeries in the field hospital surgical tent, but mostly she assisted walk-in patients. Many of them had not been hurt by the earthquake, but had other medical problems and had never seen a doctor before.

Haitians traveled by foot to see Cuban doctors — some had to walk for hours from other towns. When they arrived, they found Cubans living in tents not far from earthquake victims. The Cuban doctors felt the same heat, walked the same roads, heard the same night time noises and smelled the same smells of injury and death as did Haitians.

American doctors, in contrast, typically slept in luxury hotels in the Dominican Republic and were daily flown in and out by helicopter. While a disaster victim is grateful for any assistance given, it was clear that Cuban doctors were **of** the people and American doctors were there **for** the people (and for US TV cameras).

At the time US doctors had treated 871 patients, the Cubans had treated 227,143.

Though you wouldn't know it from watching US TV, Cuban medical staff treated vastly more patients than did American doctors. This included hundreds per day practicing internal medicine, OB/gyn, surgery, orthopedics, pediatrics, wound healing, and physical therapy. At the time US doctors had treated 871 patients, the Cubans had treated 227,143. [17]

Being part of a Henry Reeve Brigade is stressful not only due to the volume but also because a field hospital is so different from *consultorios* and *policlínicos* where most Cuban doctors work. Joanna is quick to point out that Cuban doctors in Haiti readily adjusted to this stress since most had previ-

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The Henry Reeve Brigade at Croix du Boquet was typical of Cuban emergency teams, though the number of staff varies according to location. It included:
1 orthopedic surgeon (who arrived right after the earthquake),
2 orthopedic residents,
1 anesthesiologist,
1 general surgeon,
1 OB/gyn,
2 OB/gyn residents,
2 clinicians (internal medicine, MGI),
1 pediatrician,
2 pediatric residents,
5 physical therapists,
5 nurses (who worked mainly in surgery and intensive care),
1 lab specialist,
1 x-ray/ultra sound specialist,
1 psychologist,
1 pharmacist,
1 technician,
1 epidemiologist,
3 epidemiological technicians (who mapped out where Haitians lived, and fumigated),
1 statistician (who helped with epidemiology),
1 camp manager,
1 field manager (who dealt with supplies),
1 driver,
1 cook,
1 electrician.

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ously completed several "missions" to Sri Lanka (after the 2004 tsunami) [18] or to countries such as Mozambique, Venezuela, Honduras and Angola. Additionally, Cuban doctors are very proud of their experiences in the "exterior" — it is some of the most prestigious work that any Cuban can do.

The Croix du Boquet field hospital had the basics to deal with most patients, though some of the more complicated cases were sent to another hospital or to a location for chronic diseases. Cuban doctors become resourceful at trying techniques that may not appear in medical literature but work in disaster settings.

Joanna observed several surgeries that were done with only spinal anesthesia. The surgeon had to open, complete the surgery and close in 45 minutes before the spinal wore off. She told me that surgeons could have kept people under longer but rarely did. Surgeons working in a more comfortable situation with unlimited anesthesia might dislike having to complete everything in such a short time.

Joanna reported that, not having more common anesthetics, Cuban surgeons had to rely on bupivacaina and had to alter the percentage solutions of dextrose to make it work for field surgery. Despite receiving a lower dose, none of the patients she observed expressed discomfort.

Doctors were "on call" all the time because complicated cases frequently came in. Even though the number of surgeries was often intense, they would also do patient consultations. A Cuban surgeon is expected to be a well-rounded specialist who maintains her/his capabilities in general medicine.

A major strength of Cuban doctors in a disaster setting is that they can make medical decisions quickly based on patient observation. They do not have to rely on expensive tests like the MRI, CAT scans, PCR (Polymerase Chain Reaction), X-rays or ultra-sound. They tend to use basic lab tests and turn to X-rays or ultra-sound only when it is necessary. Cuban doctors are familiar with the other tests and would use them if they were available but often make emergency decisions without them.

It appears that the US embargo, by limiting supplies to Cuban physicians, has had the unintended effect of making them more resourceful and more adaptable for emergency responses. Joanna feels strongly that limited resources mean that doctors in Cuba are not pressured to perform unneces-

sary tests and, unlike in the US, hospitals do not tell physicians to check boxes to see if every test has been done. Cuban doctors are not forced to constantly think about malpractice suits. Incompetent doctors are brought to trial where their licenses could be revoked. Really bad ones go to jail. [19]

In contrast, US physicians who are trained to see a lawsuit hiding under every hospital bed are ill-prepared to deal with a massive disaster such as the earthquake in Haiti.

Traditional and Western medicine in Ghana

When ELAM students Ivan Angulo and Joanna Souers worked with Cuban medical brigades in Peru and Haiti they did so as observers. With the creation of Student Health Brigades (BES, *Brigadas Estudantiles por la Salud*) medical students developed the opportunity to become primary actors in the new global medicine.

> **… the US embargo, by limiting supplies to Cuban physicians, has had the unintended effect of making them more adaptable for emergency responses.**

One of the most outstanding examples is the Ghana Project. Created by the Organization of African Doctors in 2009, it aims to strengthen ties between ELAM students and Cuban-trained doctors in Ghana. [20] ELAM students who carry out the Ghana Project form the Yaa Asantewaa Brigade (YAB). Born in 1840, Yaa Asantewaa was the Warrior Queen famous for leading the Ashanti uprising against British domination in the early 1900s in what is currently Ghana. [21]

In summer 2010, Omavi Bailey was 1 of 6 YAB members who went to Ghana, worked with traditional healers and made contacts and gained insight in order to develop the project into 2012 and beyond. Much of what they saw is available on YouTube in three short movies. [22]

As the report of their 2010 work describes, "In the initial phase of this medical mission the fundamental objective was to conduct an assessment of the health care resources and needs in the rural communities of Ghana's Volta Region." [23] This included building working relationships with Ghana's Ministry of Health and local community leaders, the most influential being Paramount Chief TogbegaDabra VI.

The students traveled to Logba, a small rural town in the Volta region where they stayed in the guesthouse. As would be expected for students trained at ELAM, shortly after arriving at Logba they did an assessment of water systems and living conditions, including garbage disposal. For Cuban health practitioners, examining individual patients is not sufficient: looking at issues like drinking water is an indispensable part of health assessment. The YAB students also found that attending a large community funeral ceremony was important for un-

derstanding the village's culture and being accepted as family.

The West does not understand and is often contemptuous of natural healing practiced by indigenous peoples. The Cuban MGI approach, in contrast, requires students at ELAM to study traditional and alternative medicine.

Roughly 85% of Ghanaians rely solely on traditional healers. Western medicine is unavailable, unfamiliar, and costly. Logba residents would have to travel at least 30 miles to a medical doctor or hospital. Many Ghanaians do not receive medical care because they cannot afford it. The students from ELAM met seven year old Emmanuella whose family had no way of paying for a $10,000 operation that she needs for a congenital heart malformation.

Ghanaians also prefer traditional healers. They are more comfortable with economical remedies of herbs, herbal baths, massages, counseling and meditation. YAB students saw multiple examples: a healer applying herbs to the lower back of a man to reduce his pain; a healer using massage to help a woman walk; and a girl receiving spiritual healing after a bad burn.

Nevertheless, Ghanaians are intensely aware of how a Western model must be blended with their traditional knowledge to deal with acute issues. Life expectancy is only 57 years and Ghana is plagued by high infant and maternal mortality.

YAB students saw first-hand the "brain drain" effect of 9 out of every 10 doctors leaving the country. On their first day at the clinic in Logba Tota, they arrived at 7:00 am to find 80 people waiting to see the medical team. A nurse midwife at the clinic asked the YAB to help deliver a baby, which their medical director, Dr. Sarpoma Sefa-Boakye, did. Their MGI training in Cuba prepared them well for using Western medical techniques in a community which relies on spiritual healers.

YAB students reported that their own transformation toward understanding the culture of natural medicine was the most profound aspect of their trip to Ghana. Meeting tribal chiefs and being accepted by the village was critical, not just for obtaining in-

> **For Cuban health practitioners, looking at issues like drinking water is an indispensable part of health assessment.**

formation from villagers, but also for understanding how everyday life is part of the healing system.

When I asked Omavi Bailey for examples of traditional healing methods, he described massages for certain ailments and herbs for asthma, but emphasized that there are philosophical and spiritual dimensions of health and healing that transcend specific cures. These include the cultural traditions like not eating pork and counseling patients concerning how to live better in order to avoid problems. [24]

Our conversation reminded me that the Western mindset seeks to pigeon-hole human existence into separate spheres of life: work has a time it starts and stops; democracy happens at the ballot box every so many years; religion is devoted to a given day of the week. Medicine is likewise sub-compartmentalized into discovering a certain pill for a certain illness.

YAB students saw first-hand the "brain drain" effect of 9 out of every 10 doctors leaving the country.

In order to understand traditional medicine it is necessary to appreciate how spheres of life, rather than being divided from one another, dance in an interrelated wholeness. Perceiving this wholeness created the framework for YAB students to see the necessity of blending traditional and Western medicine in a way that makes health care not just affordable but also meaningful and for people.

Conceptualizing the wholeness of human health helped the Ghana Project transition from a focus on infectious disease to hypertension. They went to Ghana with a major interest in infectious diseases that plague Africa. [25] When at the Logba clinic, they provided "primary medical attention to over 400 patients." [26] They observed traditional healers give consultations as they took vital signs and medical histories.

To their surprise, hypertension was rampant, with 59.3% of men (71/118) examined having hypertension, a history of mild stroke, or arthritis, and 46.4% of women (97/209) having the same symptoms. Realizing that infectious diseases like malaria, though prevalent, are well-studied, they decided to shift the 2011–2012 phase of the Ghana Project to investigating and treating hypertension.

As Omavi and I chatted about hypertension, we realized the dialectical interplay between Western medical knowledge, public health and cultural factors in a country such as Ghana. I recounted how I had left a physician who insisted that I control high blood pressure with drugs, found one who would work with me on diet and exercise, and that now it is under control.

Omavi noted that, though that experience is valid for many Americans, Ghanaians generally do manual labor and have hypertension despite plenty of physical activity. He wondered if disconnection from many traditional Ghanaian ways of living combined with new Western life styles could be major contributing factors to stress.

There is also the possibility that introduction of environmental toxins might weaken the body's ability to cope with stress and indirectly lead to hypertension. Omavi hopes to look at all of these during future trips. But the most important question for him is whether traditional Ghanaian healers already have treatments that might be effective for hypertension.

Students with the Ghana Project planned to spend 2011 researching hypertension, organizing and raising money to return in summer 2012. Organizing means making many phone calls and improving their web site so they can disseminate information more rapidly. But the US blockade interferes with internet and phone connections in Cuba.

Therefore, ELAM students find that they need to do much of their organizing, especially making international connections, during summer trips to the US. This is just one concrete example of how the US blockade hampers Cuban medical initiatives and slows improvement in global health.

Conceptualizing the New Global Medicine

In science, "rigorous" means that a theory withstands multiple challenging tests. The Cuban MGI model of medicine withstood the test of the "Special Period" following the fall of the Soviet Union, when oil imports almost dried up, the island's Gross Domestic Product plummeted, and 13% of the population became undernourished. [27] The US sought to strangle Cuba by a series of laws that further hampered its ability to import goods, including pharmaceuticals.

Yet, despite these severe setbacks, during the 1990s, the rate of infant mortality in Cuba continued to fall and it was able to provide medical assistance to several countries hit by hurricanes. Consequently,

… spheres of life, rather than being divided from one another, dance in an interrelated wholeness.

Cuba's MGI approach to health is perhaps the most "rigorous" meta-theory of medicine on the planet today.

The massive amount of Cuban international aid, whether measured in terms of number of emergency teams sent, doctors working overseas, medical treatments provided, or lives saved might give the impression that any country could replicate its efforts if it would only dedicate the resources to do so. This article suggests that this is **not** the case and that it is highly unlikely that the US would be able to provide the same degree of aid even if it wanted to. The quantity of assistance which Cuba has provided presupposes the social relationships of medicine which are embodied in the MGI model.

Understanding the international success of Cuban medicine requires perceiving it not as a quantity of things but as a dynamic and unfolding process of becoming. The new global medicine is not merely a set of people and instruments that one country bestows upon another but is a way of mobilizing the use of those people and instruments. The new global medicine is anything but patients sitting passively, waiting for governments to do good deeds—it is people participating in the creation and defense of health care institutions. It is realizing that health care is simultaneously a human right and something

that people define and build as they adapt techniques and knowledge to their own culture.

Observing Cuba's experience of recreating its own medical science and sharing it with the world leads to concepts which form the basis of the new global medicine.

First, it is not necessary to rely on expensive technology as the initial approach to medical care. Cuban doctors use machines that are available, but they have an amazing ability to treat disaster victims with field surgery. They are very aware that most lives are saved through preventive medicine such as nutrition and hygiene and that traditional cultures have their own healing wisdom.

Second, doctors must be part of the communities where they are working. This could mean living in the same neighborhood as a Peruvian *consultorio.* It could mean living in a Venezuelan community that is much more violent than a Cuban one. Or it could mean living in emergency tents adjacent to where

Cuba's MGI approach to health is perhaps the most "rigorous" meta-theory of medicine on the planet today.

victims are housed. Or staying in a guesthouse in Ghana. Cuban-trained doctors know their patients by knowing their patients' communities.

Third, the MGI model outlines relationships between people that go beyond a set of facts. Instead of memorizing mountains of information unlikely to be used in community health, which US students must do to pass medical board exams, Cuban students learn what is necessary to relate to people in *consultorios*, *polyclínicos,* field hospitals and remote villages. Far from being nuisance courses, studies in how people are bio-psycho-social beings are critical for the everyday practice of Cuban medicine.

Fourth, the MGI model is not static but is evolving and unique for each community. Western medicine searches for the correct pill for a given disease, with a major reason for research being to discover a new pill after "side effects" of the first pill surface. Since traditional medicine is based on the culture where it has existed for centuries, the MGI model understands limitations of transferring medical practices from one society to another.

Fifth, it is necessary to adapt medical aid to the political climate of the host country. This means using whatever resources the host government is able and willing to offer and living with restrictions. Those hosting a Cuban medical brigade may be friendly as in Venezuela and Ghana, hostile as is the Brazilian Medical Association, become increasingly hostile as occurred after the 2009 coup in Honduras, or change from hostile to friendly as expected in Peru with the 2011 election of Ollanta Humala.

Sixth, the MGI model creates the basis for dramatic health effects. Preventive community health care, a desire to understand traditional healers, the ability to respond quickly to emergencies, and an appreciation of political limitations gives Cuban medical teams astounding success. Cuba now has life expectancy equal to that in the US, infant mortality which is slightly lower and a tenth of the HIV rate. During the first 18 months of Cuba's work in Honduras following Hurricane Mitch, infant mortality dropped from 80.3 to 30.9 per 1000 live births. When Cuban health professionals intervened in Gambia, malaria decrease from 600,000 cases in 2002 to 200,000 two years later. And Cuban/Venezuelan collaboration resulted in 1.5 million vision corrections by 2009. [28]

Seventh, the new global medicine can become reality only if medical staff put healing above personal wealth. In Cuba, being a doctor, nurse or support staff and going on a mission to another country is one of the most fulfilling activities a person can do. The program continues to find an increasing number of volunteers despite the low salaries that Cuban health professionals earn.

Eighth, dedication for the new global medicine is now being transferred to the next generation. When students at Cuban schools learn to be doctors, dentists or nurses their instructors tell them of their own participation in health brigades in Peru, Haiti, Honduras, Angola and dozens of other countries. The YAB is one of many examples of medical students designing new health projects for the "exterior" of Cuba. Venezuela has already developed its approach of MIC (*medicina integral communitaria,* comprehensive community medicine) which builds upon but is distinct from Cuban MGI. [29]

Ninth, Cuba is remaking medicine across the globe. Though best-known for its successes in Latin America, Africa and the Caribbean, Cuba has also provided assistance in Asia and the Pacific Islands. Many of the countries hosting Cuban medical brigades are eager for them to help redesign their own health care systems. Cubans learn how to harmonize

The quantity of assistance which Cuba has provided presupposes social relationships of medicine …

their knowledge with the traditions of each country. Rather than pursuing a futile attempt to make expensive Western techniques available to everyone, the Cuban MGI model helps reconceptualize how healing systems can meet the needs of a country's poor.

Tenth, the new global medicine is a microcosm of how a few thousand revolutionaries can change the world. They do not need vast riches, expensive technology, or a massive increase in personal possessions to improve the quality of people's lives. If

dedicated to helping people while learning from those they help, they can prefigure a new world by carefully utilizing the resources in front of them.

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