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Cell-Phone Health In Mexico City, a program called TelSalud is harnessing the power of the telecommunications revolution to keep patients connected—to their providers, to information, and to each other.

By J. Lester Feder

REPORT FROM THE FIELD
Cell-Phone Medicine Brings Care To Patients In Developing Nations

At ten o'clock in the morning, a clinic in Mexico City's Condesa neighborhood is buzzing with activity. It serves some 7,000 patients and is operated by the Mexico City government, making it one of the largest facilities in Latin America devoted to treating patients with HIV/AIDS. More than forty people wait in line at the clinic pharmacy: hipsters in skinny black jeans; heavy-set middle-agers dressed for work. One of the tools they'll get to fight their disease is free antiretroviral drugs provided by the national government. Another tool may be one they already have in their pockets: their cell phones.

Cell-Phone Alerts For HIV Drug Compliance

Sitting at a white plastic table near the pharmacy, an HIV-positive man—we'll call him Carlos—is recruiting other patients to use a system called VidaNET (LifeNET). It's a cell phone–based system that sends text messages and e-mail to patients, reminding them to take their anti-HIV drugs, keep their doctors' appointments, and stay up to date on their lab tests. The system also sends messages about mental health and alerts patients to supplementary resources on a Web site explaining side effects from anti-HIV medications. Carlos, a skinny man sporting an Abercrombie and Fitch baseball cap, gives the system a ringing endorsement. "I like the cell phone because texts just arrive" from VidaNET, says Carlos, who takes his medicine twice daily.

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"It's really easy to use." A banner hanging across his makeshift information booth underscores the point: "VidaNET is a technological platform that helps you self-manage your health."

The VidaNET system, now being rolled out throughout Mexico, is just one of many health-related mobile-phone applications coming into use throughout the developing world. VidaNET is run by a partnership between a relatively new nonprofit, the Carso Health Institute, and the leading Mexican cellular communications company, Telcel. Both were created by the seventy-year-old Mexican businessman Carlos Slim Helú, a billionaire whom *Forbes* magazine ranked as the world's third-richest person in 2009. Slim's largest holding is a $16 billion stake in América Móvil, Latin America's biggest mobile-phone company (which owns Telcel), which has seventy-three million customers. He also owns the former national telephone company, Telmex, which operates fixed-line phone and Internet service.

Slim has done much to shape the country's telecommunications infrastructure, and his control of this sector, along with his wealth and political influence, has made him a controversial figure within Mexico. However, through the Carso Health Institute (named after the first syllable of Slim's first name and that of his late wife, Soumaya) and its parent, the Carlos Slim Foundation, Slim is now aiming to have much the same effect on health in Latin America that the foundation created by Bill Gates and his wife, Melinda, is having on global health broadly. Slim has pledged to plow $8 billion of his fortune into his philanthropies by 2011.

Among the Carso Institute's key program areas is TelSalud—roughly translated, TeleHealth—which aims to harness the power of the telecommunications revolution for health. The challenge seems especially urgent, not just in infectious disease but also as the chronic diseases of the developed world increasingly afflict developing nations like Mexico. Conditions like HIV/AIDS or diabetes demand that sufferers take an active role in managing their disease in between visits to doctors and health clinics. Adherence to prescribed medication regimens, for example, is especially important—and sufficiently rare that the World Health Organization has called patient nonadherence a "worldwide problem of striking magnitude."[1] It is bad enough that in developed countries, studies show chronic disease patients only adhere to doctors' prescriptions 50 percent of the time, on average. In developing nations, rates are often lower still.[1,2]

The Reach Of Mobile Phones

Even if people worldwide miss their medications, however, they are increasingly addicted to their cell phones. An estimated 55 percent of the world's citizens have one, and it's projected that there will be on average one cell phone for every person in the world by 2018.[3] Strikingly, 80 percent of Mexicans now own at least one cell phone; in fact, the country has more mobile phones than people.[4] A cell phone can be bought for less than the equivalent of $30, and minutes can be bought in increments of as little as $2.50. That's not exactly cheap in a country with annual per capita gross domestic product (GDP) of roughly $14,000, and where 40 percent live in poverty—but it's still low enough to put calls and texting within the reach of many. And although only 9.1 percent of Mexicans have an Internet connection at home, through Internet cafes or shared computers, about one-quarter of Mexicans are using the Web today—a 500 percent increase since 2000.[5]

As many countries or regions leapfrog over the land-line stage of telecommunications and go directly to cellular, they are tapping mobile technologies to transform their health systems. Indeed, these technologies' applicability to a range of disease-control efforts has intrigued many health specialists for years, notes Roberto Tapia-Conyer, director-general of the Carso Health Institute. Tapia-Conyer was previously vice minister of prevention and health promotion in the Mexican national health department, and he long struggled with the challenge of getting accurate disease data on a timely basis from the field. As vice minister, he eventually oversaw a partnership with a private technology company that equipped trained volunteers with personal digital assistants (PDAs) to conduct disease surveillance in their communities. He also designed programs to track the spread of disease by using PDAs to collect the results of laboratory tests on patient samples.

In particular, Tapia-Conyer placed great store in technology's ability to put more knowledge into the hands of patients—and at the likely expense of an outdated and paternalistic national health care system. Consider: Mexican law still prohibits patients from accessing their own medical records, and doctors are often too busy to explain to patients the significance of medical indicators or why they should be taking the medicines prescribed. "Physicians are mostly used to providing the medical indications and to doing the questioning," Tapia-Conyer explained in a recent interview in his Mexico City office. "The health system has to adjust to the idea of chronic disease, and also accept" that patients will have to become more involved in combating their own

With CardioNET, a typical text message underscores the importance of exercise.

chronic conditions and that providers will inevitably use some power and control.

When Tapia-Conyer moved to the new Carso Health Institute in 2007, he began shaping a strategy to more fully tap digital technology to improve Mexicans' health. Given Slim's cellular-phone interests, it was not exactly an accident that Carso initially had cell phones in mind. A tiny body of research was beginning to show that text messaging, in particular, showed promise as a tool to increase medication adherence. The policy research arm of Vodafone, a British-based cellular company, found that text-message reminders to patients in the United Kingdom reduced the number of missed doctors' appointments by 33–50 percent.[6] And a review published in the *American Journal of Preventive Medicine* of fourteen studies of text-messaging interventions found that 93 percent produced positive behavioral changes.[7]

More Mobile-Phone Solutions

So the Carso staff teamed with Telcel officials to lay the groundwork for a prototype cellular phone–based health texting system. They also brought in Voxiva, a global provider of mobile phone–based systems focused on health, to build a platform to enable the new system to manage users' data. The first prototype, dubbed Cardio-NET and launched in the summer of 2008, is a system designed to head off obesity-related illnesses by educating users on healthy eating and exercise. And with good reason: As of 2006, almost 40 percent of Mexicans were overweight, and obesity had increased almost 50 percent since 1993.

CARDIAC HEALTH With CardioNET, a typical message texted to a user underscores facts like the importance of exercise: "Regular physical activity can be done almost anywhere, and helps on your road to health: at home, at the office, on an airplane, while watching television, while waiting in line, just to name a few opportunities." The system also features a risk-assessment tool to give users instant feedback on their risk of serious illness due to obesity. It asks users for their height and weight, for their blood pressure and cholesterol levels, and whether they smoke or have diabetes. It then calculates the risk that the user will have a heart attack in the next ten years, and provides links to resources to help patients live a healthier lifestyle.

Part of the goal of CardioNET is patient education, pure and simple: instructing Mexicans on the importance of particular health indicators as a means of stimulating them toward health improvement. According to Carso operations solutions director Héctor Gallardo Rincón, studies suggest that only 5 percent of Mexicans know their blood pressure and only 3 percent know their cholesterol levels. In a survey, 88 percent of users reported that CardioNET had prompted them to change their behavior. The system currently has about 5,000 users. Carso is planning a promotional campaign through Telcel and some state governments, and hopes to have 350,000 people enrolled by the end of 2010.

HIV/AIDS In developing VidaNET, the system for HIV/AIDS patients, the Carso Institute tackled another urgent need: boosting adherence by HIV/AIDS patients to antiretroviral drug regimens that are now paid for by the Mexican government. Since antiretroviral therapy can require HIV patients to take multiple doses of medication daily, which can have unpleasant side effects, adherence rates have often lagged among HIV/AIDS patients worldwide. But anti-AIDS medications succeed in durably suppressing viral load only if patients take their medications at least 95 percent of the time.[8] What's more, when patients go off their medication regimes, this can fuel the growth of resistant strains of HIV, which can be transmitted to others.[9–11]

The Carso Health Institute unveiled the pilot version of the system during the international AIDS conference held in Mexico City in 2008. It recruited the first group of users with the help of partner organizations working with Mexican HIV patients. On the basis of feedback from 800 test users, it made key changes to the prototype, including adding a colorful and user-friendly Web interface for those who access the program online rather than via cell phone. A new user can enroll in VidaNET in two ways: by sending a text message to a special number created by Telcel, or by going online and entering information through a Web portal. (Currently, the cell-phone services are only available to people whose carrier is Telcel, since that company is transmitting VidaNET's messages free of charge.)

After setting up a password and username, the

system asks a user to enter basic medical information, including their weight and height, when they were diagnosed HIV-positive, and how long they have been on antiretroviral therapy. They then input the times they are supposed to take their medication, the dates of upcoming doctors' appointments, and results of lab tests for T-cells, viral load, and hemoglobin. The system automatically sends them reminders to keep them on schedule. It also sends educational messages such as, "Resistance to pharmaceuticals can occur if you do not take the prescribed dose, if you take it incorrectly, or if you absorb the medications at a low rate. If that occurs, it's important to identify the origin of that resistance."

Carlos—the HIV patient who was recruiting users at the Mexico City clinic—says what he likes best about VidaNET is its version of the risk-assessment tool first introduced in CardioNet, known in VidaNET as the "stoplight." Patients fill out a short survey that asks how many times they have forgotten to take their medicine over the previous four days. Since antiretroviral drugs only work with near-perfect adherence to the regimen, a patient who reports missing just one dose receives a "yellow light," and a message that reads, "You've achieved an 87.5 percent level of adherence to your medications. This level is high—improve it, and you'll feel better." If the patient forgets twice, only reaching a compliance level of 75 percent, a "red light" warning appears, along with a stronger message: "Don't let the virus continue replicating." In all capital letters it advises, "LOOK FOR SUPPORT AND VISIT YOUR DOCTOR."

Privacy And Security

This kind of anonymous interaction may seem impersonal. But on the other hand, cell phones may actually produce more honest and accurate adherence reports, since patients frequently exaggerate their degree of medication adherence when asked about it directly by providers. VidaNET also appears to have accomplished its sponsors' goal of making Mexican patients feel more empowered vis-à-vis their health care providers, since they now have far better access to information and assistance incorporating their medical routine into daily life. At the same time, however, many patients have expressed concerns about the system's privacy. "Everything can be seen on the Internet," Carlos says, "People worry [that their] information can be tracked."

VidaNET has sought to allay such concerns by not asking users to submit any identifying information beyond their mobile-phone number. This does not entirely put fears to rest, however, especially since a new federal law requires all cell-

Technology is unlikely to be the whole solution to Mexico's health challenges.

phone users to register their number in a national database along with their name, place and date of birth, and an identification number. Although these data are sealed by law, there is concern that this protection may not be airtight.

The Carso Institute now aims to recruit more patients in the Ministry of Health's clinics and have as many as 10,000 people using VidaNET by the end of 2010. But as enthusiastic as many seem about the prospects of VidaNET and other mobile phone–based interventions, there's also a keen desire now to make sure that such systems really deliver results. José Antonio Izazola Licea, director of Mexico's National Center for HIV/AIDS Control and Prevention, is encouraging the Carso Institute to conduct a careful and scientifically designed study in conjunction with the system's rollout. "You still need to learn how much does [a text-messaging intervention] really help people," he says. "Not us physicians, not us sitting here—real people. How is it to have a cell phone ring four times a day?" Common sense, though, suggests that VidaNET will help. "The bet here is that it's very attractive because cell-phone usage is integrated already into everyday life," he says. Before such systems are rolled out broadly, "it makes a lot of sense to try to test if this works."

DiabeDario For Diabetes Compliance

Carso is now in the final stages of preparing its most ambitious mobile health project yet: Diabe-Diario, which roughly translates as Diabetes Diary. According to the World Health Organization, about one in nine Mexican adults now have diabetes, and about one in seven of those living close to the U.S. border have the disease.[12] The condition and its consequences also constitute the country's number-one cause of death (55 per 1,000 deaths).[13] The World Health Organization estimates that Mexico's direct and indirect costs of diabetes alone were more than $15.1 billion in 2003.[14]

Like CardioNET and VidaNET, DiabeDiario will help users track their basic health indicators,

including their blood sugar levels, and will coach them on adherence and healthy living. Carso is also hoping to promote DiabeDiario by licensing it to commercial partners, such as drug companies. Although DiabeDiario would remain free for patients, licensing fees from pharmaceutical companies could provide revenue that could help fund CardioNET and VidaNET on an ongoing basis.

For various reasons, DiabeDiario is a more complex system than either CardioNET or VidaNET, and this has led to technical difficulties that have delayed its launch. But the scope of Mexico's diabetes problem is such that, if successful, DiabeDiario could have the biggest overall impact on Mexican health care. At the same time, Carso's leadership knows that technology is unlikely to be the whole solution to Mexico's health challenges. Rather, they hope it will be a means toward a more fundamental transformation that starts with better-informed patients. "Technology's going to generate equilibrium of knowledge between the health provider and the patient," says Tapia-Conyer.

Tools For Transformation

At the Mexico City HIV clinic, Carlos has seen these mobile health tools transform HIV/AIDS care for himself as well as for new patients starting treatment. With VidaNET, he says, patients "have more power" to drive their own care and convey their concerns to doctors. In fact, it's not too much of an exaggeration to say that e-health could help to bring about a "democratization" of illness in countries like Mexico—now that access to much of the world's medical expertise is increasingly just a text message away. ∎

NOTES

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Errata

ZINNER ET AL. (10.1377/ hlthaff.28.6.1814) The first page of the article by Darren E. Zinner and colleagues (Nov/Dec 09) contained several errors. First the second author's name should be Dragana Bolcic-Jankovic. Second, the Bayh-Dole Act was passed in 1980, not in 1989 as erroneously noted. The authors and *Health Affairs* regret any confusion these errors might have caused. The article has been corrected online.

HECHT ET AL. (10.1377/ hlthaff.28.6.1591) The paper by Robert Hecht and colleagues (Nov/Dec 09) contained several inadvertent numerical errors, none of which affect its conclusions. First, in Exhibit 2 on page 1595, the "millions" in the *y* axis legend should be "billions" instead. Next, on page 1600, in the paragraph beginning with the bold subheading "Outlook for donor financing," endnote 26 belongs at the end of the final sentence. In the next paragraph, the figure US$42 trillion should be US$61 trillion, and the figure US$105 billion should be US$155 billion. Next, on page 1601, at the top of the page, the figure US$294 billion should be US$425 billion, and the endnote at the end of that paragraph should be

deleted. Finally, on page 1605, endnotes 26 and 27 should be transposed. The authors and *Health Affairs* regret any confusion these errors may have caused. The article and exhibit have been corrected online.

SCHELLEKENS ET AL. (10.1377/ hlthaff.28.6.1799) The preferred name of one of the coauthors of the paper by Onno P. Schellekens and colleagues (Nov/Dec 09) is Tobias F. Rinke de Wit. The article has been corrected online. *Health Affairs* regrets any confusion this error may have caused.

BUNDORF ET AL. (10.1377/ hlthaff.28.5.1294) In Exhibit 2 in the paper by M. Kate Bundorf and colleagues (Sep/Oct 09), the bar segments for "Pharmaceuticals" had their colors reversed. The values should have been 72% quantity (gray) and 28% price (black), not the reverse. The article has been corrected online. *Health Affairs* regrets any confusion this error may have caused.

GOLD (10.1377/hlthaff.28.1.w41) Exhibit 3 in the Web Exclusive by Marsha Gold (24 November 2008) has been corrected and replaced online. Modifications have been made in the first two rows providing statistics on premiums in the lowest-premium

Medicare Advantage prescription drug (MA-PD) plan. The original data were in error because the data source (the Centers for Medicare and Medicaid Services' Medicare Options Compare data file) changed how premiums were reported in 2008, leading the author to inadvertently double-count Part D premiums in the combined Part C/D premium reported. With the change, 2008 mean monthly premiums in the lowest-premium plans (weighted by enrollment) were an average of $21 per month, less than the $29 per month originally reported. These changes do not alter the analysis in the text or the conclusions reached in the paper.

There are minor changes in a few other statistics in Exhibit 3 because the modification led to a one-plan shift in which plans were reported as lowest-premium. The author also has taken this opportunity to modify the number of plans reported to reflect only lowest-premium MA-PD plans. (The original exhibit showed total Medicare Advantage plans of each type.) Also, on page W46 (in the last paragraph), the reference to HMOs' mean monthly premiums should be $18 per month and 64 percent with no premiums, consistent with the revised exhibit. The author and *Health Affairs* regret the need for this revision.