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Resources for Child Health

REACH

SOLAR COLD CHAIN ISSUES

The application of vaccination in developing countries has met with a number of economic, operational, and technological difficulties. One of the main problems is the need to provide refrigerated storage and transportation for vaccines, known as the "cold chain", from the time of manufacture until the vaccines are finally administered in the developing nation. To remain potent, most vaccines must be maintained at temperatures between 0 and 8 C. For the more sensitive polio and measles vaccines, a -20 C. temperature is recommended for extended storage. This means maintaining an unbroken "cold chain" for months, across the continents, with many individuals and organizations involved, and with a single failure at any point, diminishing or altogether destroying the potency and effectiveness of the vaccines. Some vaccines are threatened by as little as an hour's exposure to the normal temperatures found in many developing countries

Previous technical solutions to the problem of maintaining a cold chain were based primarily on the presumption of a dependable supply of electric power, which is either unreliable or altogether absent in many areas. Two thirds of the rural areas in the developing world are without electricity and approximately 75 percent of the population that needs to be served by immunization programs live in areas without a reliable supply of electricity. Where electricity is not an option, vaccines are usually stored in absorption cycle, kerosene or lp gas powered refrigerators. In these units, refrigeration is provided by heating a pressurized ammonia solution to its boiling point. They suffer from a multitude of problems, including high maintenance requirements, lack of fuel availability, high fuel costs and a lack of temperature control. Vaccine transportation and storage in many developing countries is especially difficult because many areas have hot or tropical climates with ambient temperatures higher than those for which some of these refrigerators were designed to operate. These factors, when combined with the difficulty in supplying adequate spares and fuel, training non-technical personnel in how to maintain and operate a maintenance intensive system, and similar demands, clearly call for a better option.

Over the past five years at least 800 photovoltaic medical refrigerators have been installed in developing nations. That number was correct as of last October - it is probably badly out of date by now. While the first of these installations were for testing and demonstration, a number of current systems can be considered truly operational. Since 1985, WHO and UNICEF have included photovoltaic refrigeration equipment in their annual procurement guide to cold chain products. This signals the acceptance of photovoltaics as an operational rather than an experimental

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technology. Whereas kerosene refrigerators are only 50-85% reliable in maintaining proper storage temperatures in field conditions, some of the more mature photo-voltaic installations are demonstrating 90 to 100% reliability in the same types of operating environments. Additionally, because of their higher reliability, photo-voltaic systems are establishing themselves in some areas as the most cost-effective option in terms of the number of vaccinations provided versus dollars spent. While the initial installation costs for photo-voltaic systems is still higher than for kerosene or gas units, the photo-voltaic's lower long run operating costs and higher reliability can recoup this difference. In Sudan, AID is helping the government to set up a fuel-free national cold chain using US made solar refrigerators to maintain the potency in vaccines. This will permit the immunization program to reach many outlying districts and, at the same time, to save on outlays on kerosene. A similar expansion to the cold chain is under way in Somalia with funding from AID's child survival grant to the United Nations Development Program.

In discussing solar technologies in developing world health programs, however we need to be careful that we aren't sidetracked into only discussing their technical advantages over the older gas and kerosene technologies, forgeting the environments in which they both operate.

The technical difficulties in maintaining the cold chain in these environments are obvious: tropical climates, poor roads, inadequate supplies, limited maintenance, poorly trained technicians, limited supervision.....those familiar with the cold chain can easily add their own experiences to this brief list. While the hardware and technical considerations are important, they are not the only, or even the most important issues. Any technology, no matter how much more efficient or improved over existing ones is still subject to the human factor.

Often, a "typical" immunization program in a developing country will have only one or two well trained managers for the entire program. These managers will likely be based in the capital, have a medical rather than an engineering background and be so overworked that access to them will be quite limited. Accordingly, they may not be an effective resource when it comes to solving technical problems regarding the cold chain. Generally, a specific cold chain technician will be available in the national capital (or perhaps regional capitals in large countries), but only rarely will one find well trained technicians in actual field settings. Indeed, even the senior level technicians will probably have little, if any, familiarity with solar technologies and those working in areas without reliable electricity (most areas), will also have little or no electrical background. That is the environment in which solar equipment will be placed. It is certainly not an ideal one, but it is the reality of the situation and the equipment must adapt to it- not the other way around.

Add to this the resistance to new ideas and ways of doing things, political difficulties ranging from large scale national upheavals to the simple jealousies and rivalries among programs and personalities found in any working environment. Solar technologies, indeed no technologies can address these factors completely. Any system that can make fewer demands on the operating environment in terms of resources, maintenance requirements and operational tolerances is going to have an advantage over

more the more demanding older technologies, but an advantage is not the same thing as a solution.

Sustainability has become a key issue in development circles. Can the programs and technologies we are introducing be maintained with local resources, both financial and technical, after the outside sources of support have left? Based upon the questions already raised, the answer isn't altogether clear. On one hand, solar technologies hold out the promise of being simpler to maintain by virtue of being independent of recurring fuel costs and having greatly reduced maintenance requirements. On the other, what will happen if a unit needs to be relocated? Who will be available on site to re-align the collecter panels? To replace a faulty voltage regulator? Who will bear the costs of replacing battery units? In many cases these are skills and resources not currently available in many of the areas solar units are sited. Certainly training and projected spare parts requirements are included in all project designs but often these projections are overly optimistic. After all, WHO and UNICEF have been supporting existing cold chain technologies for a number of years with uneven record of success. But this mixed record is certainly not for lack of excellent training materials, frequent hands-on technical workshops for field personnel, long-term resident technical experts and the best efforts of hundreds of competent and dedicated staff. Indeed, it is difficult to suggest how they could improve upon their current efforts.

In the end, however, it comes down to the fact that we don't always take care of our machines the way we should- we don't read the operating manuals before plugging in the units, we try to cut corners on maintenance when we really know better, and so on. Nor are these problems particular to the developing world alone. They are raised not to dismiss solar as an option, but rather to make sure it works as in the field as we all hope it will.

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