Vaccine 33 (2015) 908–913

Contents lists available at ScienceDirect

Vaccine

journal homepage: www.elsevier.com/locate/vaccine

Optimizing energy for a 'green' vaccine supply chain

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ARTICLE INFO

Article history:
Received 29 January 2014
Received in revised form 28 August 2014
Accepted 21 October 2014
Available online 17 November 2014

Keywords:
Vaccines
Supply
Coldchain
Energy
Solar
Immunization

ABSTRACT

This paper describes an approach piloted in the Kasserine region of Tunisia to increase the energy efficiency of the distribution of vaccines and temperature sensitive drugs. The objectives of an approach, known as the 'net zero energy' (NZE) supply chain were demonstrated within the first year of operation. The existing distribution system was modified to store vaccines and medicines in the same buildings and to transport them according to pre-scheduled and optimized delivery circuits. Electric utility vehicles, dedicated to the integrated delivery of vaccines and medicines, improved the regularity and reliability of the supply chains. Solar energy, linked to the electricity grid at regional and district stores, supplied over 100% of consumption meeting all energy needs for storage, cooling and transportation. Significant benefits to the quality and costs of distribution were demonstrated. Supply trips were scheduled, integrated and reliable, energy consumption was reduced, the recurrent cost of electricity was eliminated and the release of carbon to the atmosphere was reduced. Although the initial capital cost of scaling up implementation of NZE remain high today, commercial forecasts predict cost reduction for solar energy and electric vehicles that may permit a step-wise implementation over the next 7–10 years.

Efficiency in the use of energy and in the deployment of transport is already a critical component of distribution logistics in both private and public sectors of industrialized countries. The NZE approach has an intensified rationale in countries where energy costs threaten the maintenance of public health services in areas of low population density. In these countries where the mobility of health personnel and timely arrival of supplies is at risk, NZE has the potential to reduce energy costs and release recurrent budget to other needs of service delivery while also improving the supply chain.

1. Introduction

Maintaining the vaccine supply chain from manufacturer to population in need is vital for the success of immunization programmes and requires highly efficient systems and technologies to be sustained, especially in resource-challenged areas. The process requires that vaccines are kept cool in a cold chain at all times during storage and transport from the national warehouse up to remote health centres. High performing and efficient distribution, combined with rigorous vaccine handling are already critical success factors in the best existing systems of global distribution.

However, many countries still suffer from chronic vaccine distribution failures due to irregular and unreliable shipments. In these countries access to transport is uncertain and poorly planned and vaccine storage conditions are not continuously monitored [1]. As the number, volume and value of vaccines and temperature-sensitive medicines steadily increases globally, the need to address supply chain challenges in these countries becomes increasingly urgent.

'Net zero energy' (NZE) is a concept to raise energy efficiency of buildings and processes by reducing energy consumption and waste to the minimum and by generating sufficient renewable energy on-site to offset the consumption of grid electricity (grid-linked) [2]. In this case NZE was applied as the lead concept in a selection of managerial interventions to streamline the storage and transport of vaccines and medicines of 'net zero energy' (NZE).

In Tunisia, a country where sun is in abundance and energy costs are escalating, where switching to renewable energy is a national priority and where the solar industry is growing, the Ministry of Health readily engaged in project Optimize [3] proposition to pilot the benefits of applying the NZE approach to the Tunisian vaccine supply chain.

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http://dx.doi.org/10.1016/j.vaccine.2014.10.053