# Meeting Requirements for Controlled Room Temperature Storage of Medicines

October 2012

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PATH World Health Organization

This report was commissioned by Optimize: Immunization Systems and Technologies for Tomorrow, a World Health Organization and PATH collaboration. The report was authored by John Lloyd and Steve McCarney, consultants.

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Suggested citation:
PATH. *Meeting Requirements for Controlled Room Temperature Storage of Medicines*. Seattle: PATH; 2012.

This work was funded in whole or part by a grant from the Bill & Melinda Gates Foundation. The views expressed herein are solely those of the authors and do not necessarily reflect the views of the Foundation.

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# Table of contents

Acronyms ..... v
Executive summary ..... vi
Introduction ..... 1
Method ..... 2
  Assessment of storage parameters ..... 3
  Engineering assessment of feasibility and system requirements for five potential alternative solutions ..... 4
    Natural or passive conditioning ..... 4
    Part-time space conditioning ..... 4
    Full-time space conditioning ..... 4
    Specialized space conditioning and humidity control ..... 4
    Conditioned room within a room or kit cool room refrigerator ..... 5
    Improving the thermal integrity of roof, walls, windows, and doors ..... 5
  Analysis and synthesis of feasible solutions ..... 5
Results ..... 5
  High energy consumption ..... 6
  High energy consumption ..... 6
  Low energy consumption; size applicable to region ..... 6
  Solution 1: Natural or passive conditioning ..... 6
  Solution 2: Part-time space air-conditioning ..... 6
  Solution 3: Full-time space air-conditioning ..... 6
  Solution 4: Specialized space conditioning and humidity control ..... 6
  Solution 5: Room within a room or kit cool room ..... 7
    Optimal choice among the five alternative solutions ..... 7
Discussion ..... 8
Annex 1. Packed volumes of CRT medicines in Tunisia ..... 10

## Acronyms

| | |
|---|---|
| CRT | controlled room temperature |
| CSB | basic health centers |
| CTC | controlled temperature chain |
| DRSB | Tunisian Ministry of Health, Department of Preventive Medicine |
| HVAC | heating, ventilating, and cooling |
| PATH | Program for Appropriate Technology in Health |
| PCT | Central Pharmacy of Tunisia |

# Executive summary

Currently, Tunisia does not store medicines labeled for controlled room temperature (CRT) storage in temperature-controlled conditions at the regional level or lower levels of the supply chain. Project Optimize and the Tunisian Ministry of Public Health are collaborating to explore new logistics and supply chain solutions that can optimize the vaccine supply chain. Anticipating that the Tunisian government will soon formulate a CRT policy, as these policies already exist in Europe and the United States, project Optimize commissioned a study assessing the least-cost, most energy-efficient solution for pharmaceutical stores at the regional and district level. Tunisian engineering consultants, commissioned by Optimize for this study, evaluated five potential solutions. The study concludes that of the five solutions evaluated, one is the best when sized respectively for regional and district applications. The selected solution is an insulated chamber with temperature control to maintain 15°C to 25°C even in extreme summer and winter conditions in Tunisia. To achieve acceptable levels of energy efficiency, investment is also required to insulate and to seal the existing, aging building structure. The significance of this finding for project Optimize reaches beyond the appropriate storage of medicines because in the future some vaccines may be stored and transported in a controlled temperature chain, and there may be opportunities in the future to integrate the storage of different CRT products in dedicated, high energy-efficient warehousing.

# Introduction

In anticipation of alternate vaccine storage temperature licensing in the future, project Optimize conducted this study to assess the present practices for storing medical products at temperatures greater than the traditional vaccine cold chain (2°C to 8°C). Project Optimize is a collaboration between the World Health Organization and PATH to identify ways in which supply chains can be optimized to meet the demands of an increasingly large and costly portfolio of vaccines. The focus of the study was at the regional and district levels in Tunisia, a participant country in project Optimize.

About one-third of the medicines manufactured in Europe and the United States are now being tested and labeled for storage at controlled room temperature (CRT), mostly in the range of 15°C to 25°C at a relative humidity of 60%, and the proportion is increasing. Yet in developing countries where temperature and humidity can be far outside this range, there is little evidence that a suitable and controlled temperature chain (CTC) is being established for CRT medicines. No vaccines are stored at CRT conditions at present.

Tunisia has not yet regulated locally manufactured medicines for CRT storage and does not explicitly require central pharmacy stores to provide an appropriate CTC for imported medicines, many of which are labeled for CRT storage. By contrast, certain medicines requiring refrigeration (2°C to 8°C) are listed with this requirement in the national drug list, and pharmaceutical stores at every level of the distribution chain store them in refrigerators or cold rooms.

Project Optimize in Tunisia examined the impact of streamlining the distribution chain to meet the needs and expectations of the future (2015–2020) by a range of interventions including the physical integration of delivery systems for medicines with vaccines and establishing a highly efficient and effective CTC. In this context, the project investigated the challenges and benefits of different cooling options for CRT storage for medicines at regional- and district-level stores.

Future national regulations will almost certainly be aligned with international requirements for CRT drug storage. Furthermore, project Optimize is examining the feasibility of progressively migrating the more heat-stable vaccines towards a CTC that resembles the CRT requirements for medicines. Perhaps, in the future, there will be a combined CTC for medicines and vaccines—with sub-zero freezing, refrigeration at 2°C to 8°C, and a CTC at 15°C to 25°C.

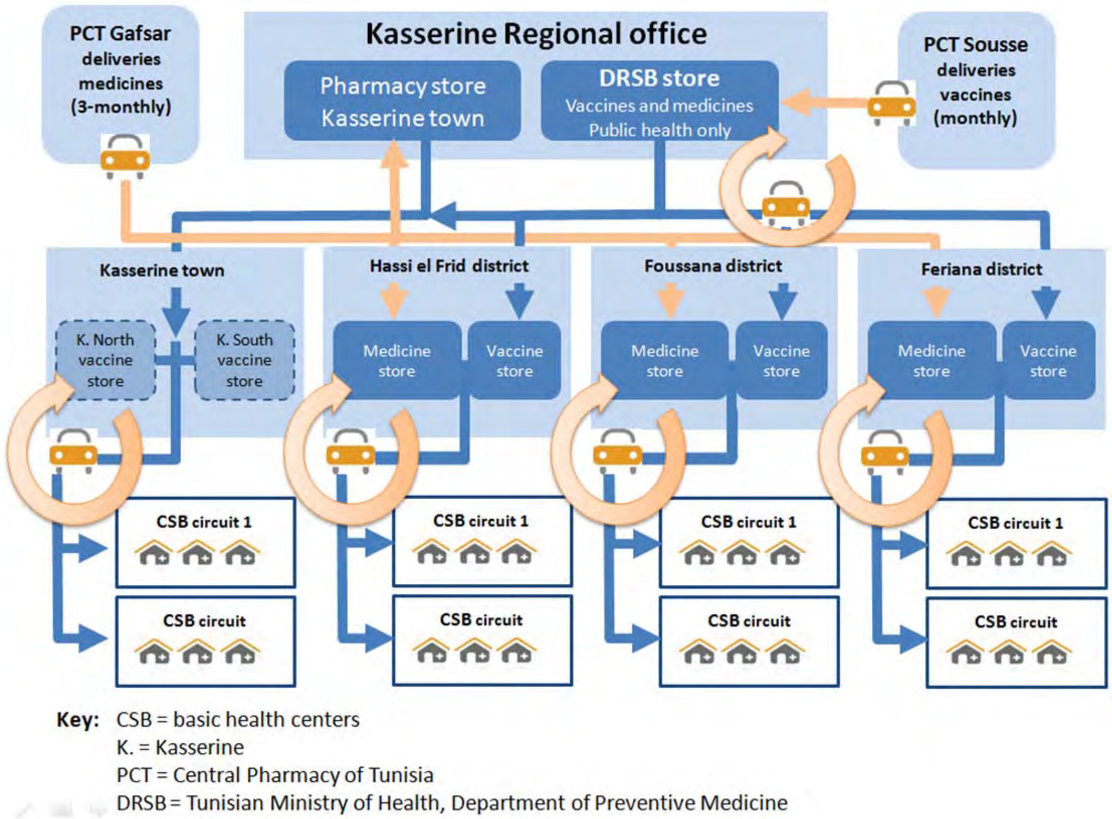
But the primary aim of this study is to assess the least-cost, most energy-efficient solutions for controlling the temperature of storage at the regional and district levels of medicines classified for CRT. The specific objectives of the study in Tunisia were to:

- Gain experience with CRT storage requirements in preparation for the possibility of future vaccines licensed for storage within an alternate CTC similar to CRT.
- Assess the most economical solutions for storage of CRT medicines in the context of regional- and district-level stores in Kasserine, Tunisia.
- Propose priorities for actions to prepare the country for compliance with international CRT regulations.

## Method

The study focused specifically on the storage of CRT medicines at one regional store and one out of three district stores in the Optimize project zone of Kasserine, a region of west central Tunisia. Figure 1 shows the distribution system of medicines and vaccines during the project.

**Figure 1.** Summary of distribution system of medicines and vaccines in Kasserine, Tunisia




The study was conducted in three steps:

1. Assessment of storage parameters.
   a. *Packed volume of medicines for CRT storage.*
   b. *Assessment of monthly ambient temperature profile.*
   c. *Energy audit of the regional store and three district stores.*

2. Engineering assessment of the feasibility and system requirements for five potential alternative solutions with and without building improvements to roof, walls, and floor to achieve better environmental efficiency.
   a. *Natural or passive conditioning.*
   b. *Part-time space conditioning.*
   c. *Full-time space conditioning.*
   d. *Specialized space conditioning and humidity control.*
   e. *Dedicated conditioned room within a room or dedicated storage cabinet (i.e., kit cool room with heater).*

3. Analysis and synthesis of feasible solutions.

## Assessment of storage parameters

The project team estimated *the maximum volume of packed medicines* labeled for CRT storage sufficient for three months in the Kasserine regional store and one of the three project districts (see Table 1). The estimates were based on a review of the medicines in current use in the region (see Annex 1).

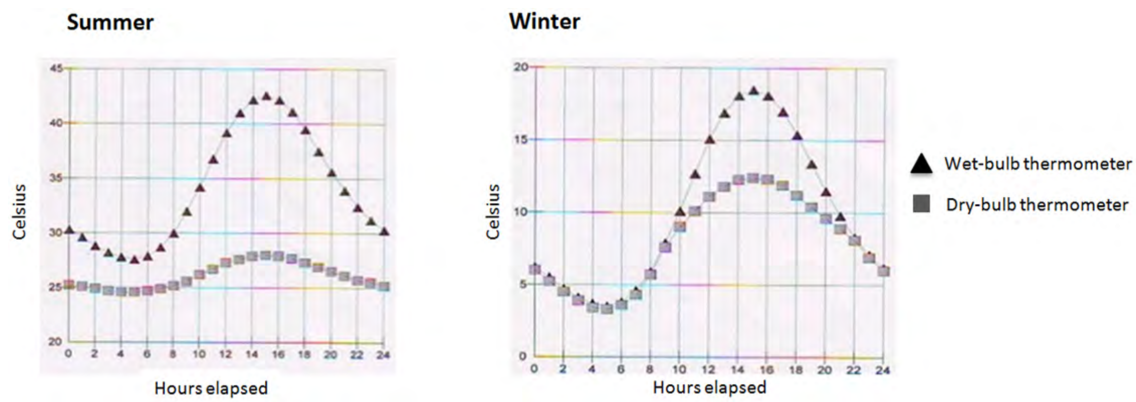
**Table 1.** Estimated packed volume of medicines by store

| Store | Packed volume or CRT drugs per 3-month supply interval[a] | | CRT as percent of all medicines |
|---|---|---|---|
| | L summer maximum | L winter maximum | % of medicine types |
| District: Hassi el Frid | 780 | 2,500 | 33% |
| Region: Kasserine | 8,820 | 14,700 | 33% |

a. Increasing at 10% per year.

*A climatic assessment* was made of the monthly ambient temperature profile in the region of Kasserine (see Figure 2). The climate in Kasserine requires both heating and cooling with cooling the dominant requirement. Solar heat gain is a significant factor that was also included in the assessment.

**Figure 2.** Monthly ambient temperature profile in Kasserine




*An initial energy audit* was made of each pharmaceutical store. The audit was limited to the storerooms and included direct observations of the energy-consuming aspects of the stores including the heating, ventilating, and cooling (HVAC) system; building envelope construction; and appliances, focusing mainly on refrigeration. The policies that addressed space conditioning of these stores were obtained by interview of regional and on-site district management staff.

From this initial review, it was apparent that the ministry of health does not allow continuous space conditioning by mechanical HVAC, although some had space conditioning only during working hours. The reason given was the cost to condition these spaces continuously was considered to be prohibitive. Three of the stores were part of a larger building and were served by the HVAC equipment and policies of the larger building. The equipment was not consistent between the stores and included central heating systems, portable heaters, wall-mounted unit air conditioners for cooling, or no HVAC equipment. Project Optimize's scope for this activity was limited to the stores and therefore did not address the larger building (e.g., central heating systems).

## Engineering assessment of feasibility and system requirements for five potential alternative solutions

Tunisian HVAC consultants[i] conducted a study of the design feasibility and system cost of five alternative cooling solutions with and without retrofit improvements to the thermal integrity of the building envelope. PATH selected the consultants by a competitive bidding process, and they conducted the assessment and submitted their final report to Optimize on November 3, 2011.[ii]

First, the consultants assessed the base-case thermal integrity of a large store in its present state of repair and the base-case thermal integrity of a representative small store in its present state of repair. They then assessed the feasibility of each solution against the CRT requirements of the regional store and the representative CRT requirements of one of the three district stores, (i.e., Hassi el Frid).

The five solutions assessed included:

1. Natural or passive conditioning.
2. Part-time space conditioning.
3. Full-time space conditioning.
4. Specialized space conditioning and humidity control.
5. Conditioned room within a room or kit cool room refrigerator.

### Natural or passive conditioning

The consultants then assessed by calculation construction and heat flow of the walls and ceilings. The air infiltration of the envelope was not quantifiable without direct on-site measurement. The internal and external heat gains as well as the mass factor of the building were estimated by the consultants to account for thermal energy storage. This option could be either a dedicated room for CRT storage or a multiuse room (shared).

### Part-time space conditioning

Assuming the base-case thermal integrity of the stores, estimates were made of the HVAC equipment that would be needed to condition the storage space for CRT, assuming that the HVAC equipment would only operate during the working day. This option could be used either as a dedicated room for CRT storage or a multiuse room (shared).

### Full-time space conditioning

Again, assuming the same base-case thermal integrity of the stores, estimates were made of the HVAC equipment that would be needed to condition the storage space for CRT, assuming that the equipment could operate as required and up to continuous operation 24 hours per day. This option could be used either as a dedicated room for CRT storage or a multiuse room (shared).

### Specialized space conditioning and humidity control

This solution was a refinement of the full-time space conditioning option by employing tandem specialized HVAC equipment to keep a narrow temperature range within CRT and

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[i] Energy and Environment Engineering (EEE), Espace Tunis, Bloc E 4ème & 5ème étages—1073 Rue 8011 Montplaisir, Tunis / TUNISIE.
[ii] Final consultants report: *Comparison D'options de Stockage a Temperature Ambiente Controlee, Kasserine et Hasil el Frid*. Tunis, Tunisia; EEE; 2011.

adding humidity control. This equipment could operate as required and up to continuous operation 24 hours per day. This option could be either used as a dedicated room for CRT storage or a multiuse room (shared).

### Conditioned room within a room or kit cool room refrigerator

The four solutions above utilize the existing store in an existing building without modification. This last solution considers the feasibility of two alternative types of space-conditioning equipment, an insulated cool room (with heating) constructed inside the storeroom and a kit cool room installed inside the store. This option is strictly a dedicated room or dedicated cabinet for CRT storage.

### Improving the thermal integrity of roof, walls, windows, and doors

Retrofitting improvements to the thermal integrity of the store is applicable to all five solutions. Methods of retrofitting included:

- Insulating the roof from the outside (insulating foamed cement render).
- Insulating the walls from the inside (rigid-foam panels attached to the wall surface).
- Reducing air infiltration by sealing building openings (e.g., wall cracks), replacing the doors with well air-sealed units, and replacing the windows with well-sealed double-glazed windows.

### Analysis and synthesis of feasible solutions

For each option, the consultant report included an opinion of the feasibility of the solution. For each feasible solution, the report included the annual electrical energy consumption (kWh/year), the annual energy cost (Tunisian Dinar [DT]/year), and the capital cost to install the option (Tunisian Dinar).

The consultant considered several options unfeasible including Option 1 (natural conditioning) and Option 5 (room within a room or kit cool room).

Subsequent work undertaken by project Optimize challenged the consultant’s conclusion of Option 5. The challenge was based on energy consumption reported by the manufacturers of dedicated cabinets that was significantly lower than any of the retrofit options analyzed by the consultant.

## Results

The results of the feasibility assessment of the five alternative solutions in conjunction with retrofit improvements to the building envelope are summarized in Table 2.

**Table 2.** Summary of feasibility assessment of five alternative solutions

| Solution no. | Solutions | Feasible/economical? Region Yes/No | District Yes/No | Remark |
|---|---|---|---|---|
| 1 | Natural or passive conditioning | **No/No** | **No/No** | Insufficient control |
| 2 | Part-time space air-conditioning | **No/No** | **No/No** | Insufficient control |

| Solution no. | Solutions | Feasible/economical? Region Yes/No | Feasible/economical? District Yes/No | Remark |
|---|---|---|---|---|
| 3 | Full-time space air-conditioning | **Yes/No** | **Yes/No** | High energy consumption |
| 4 | Precision air-conditioning and humidity control | **Yes/No** | **Yes/No** | High energy consumption |
| 5 | Conditioned within a room | **Yes/Yes** | **Yes/No** | Low energy consumption; size applicable to region |
| 5 | Kit cool room | **Yes/No** | **Yes/Yes** | Low energy consumption; size applicable to district |
| Applicable to all solutions. | Retrofit building improvements: roof, walls, floor | **Yes/Yes** | **Yes/No** | Reduction in consumption, 33% Kasserine and 11% district |

### Solution 1: Natural or passive conditioning

Natural space conditioning for heating, cooling, and humidity in new construction is a design challenge in many climates. Retrofit applications on existing buildings compound the challenge. The consultants therefore concluded that the stores buildings had insignificant natural air-conditioning effect. They noted that the buildings are 30 to 50 years old, have uninsulated concrete flat roofs and block walls with open structural cracks, and have poorly fitting doors and windows. The internal temperature can therefore be expected to follow the external ambient fluctuations with a small delay, so this solution is not considered feasible either at the regional or district level by the consultants.

### Solution 2: Part-time space air-conditioning

To maintain temperatures suitable for human occupation, the current practice in the stores is to use the existing air-conditioning equipment in the stores during the working day but to switch off the equipment at night and through weekends. During these periods the internal temperature can be expected to quickly reach the external ambient temperature, so this solution also is not considered feasible at the stores or at the regional or district levels by the consultants.

### Solution 3: Full-time space air-conditioning

Continuous space conditioning can attain CRT temperature control but does not include humidity control. Currently, neither the stores nor other areas of the facilities visited were continuously air-conditioned. The poor environmental performance of the building would, however, make this a costly solution due to high energy consumption, high maintenance requirement, and higher equipment replacement costs than Solution 2.

### Solution 4: Specialized space conditioning and humidity control

While a shared store containing CRT medicines, supplies, and working areas appears to be attractive, the cost to provide full CRT space conditioning was found to be the most expensive option. Full CRT with humidity control is only attainable with specialized HVAC equipment that is not common to the study area. Vaccine storage requirements do not require humidity control. This is an important distinction for future efforts to attain CRT.

For CRT storage of medicines, this solution would have the best control of temperature and humidity but at the highest operating cost and be optimal only for larger, regional stores.

### Solution 5: Room within a room or kit cool room

Solution 5 proposes two sizes of conditioned space for CRT storage of medicines:

- A dedicated, conditioned room constructed within the storeroom, suitable for larger regional stores (15,000 L) at Kasserine.
- A kit cool room (with heating), suitable for district stores (2,500 L) at Hasil el Frid.

Both the room within a room and the dedicated kit cool room would be located within a store with part-time space conditioning for human comfort, assuming that other dry stores and medicines may be stored in the same space.

### Optimal choice among the five alternative solutions

Technically feasible solutions were therefore considered to be Solutions 3, 4, and 5. Tables 3 and 4 below show that Solution 5 is both more energy efficient and more economical to install and to run than other feasible solutions. These comparisons of energy and cost include savings in energy and energy cost derived from two “retrofit” thermal improvements made to the regional and district stores:

- Insulation of the internal surface of the external walls.
- Insulation of the external surface of the flat roofs above the stores.

A third improvement, the replacement of doors, windows, and frames was evaluated but excluded from the energy/cost estimates due to amortization rates over ten years and high installation cost. Table 3 compares the costs and savings of the two interventions listed above.

**Table 3.** Impact of retrofit interventions on energy efficiency and cost

| Stores | | Installation cost (DT) | Operating costs | | |
|---|---|---|---|---|---|
| | | | Energy saved (kWh/year) | Cost saved (DT/year) | Amortization (years) |
| | **Regional store** | | | | |
| 1 | Wall insulation | 5015.00 | 11388.00 | 517.00 | 9.70 |
| 2 | Roof insulation | 1380.00 | 13844.00 | 629.00 | 2.19 |
| | **District store** | | | | |
| 1 | Wall insulation | 1020.00 | 2316.00 | 105.00 | 9.71 |
| 2 | Roof insulation | 287.00 | 2844.00 | 131.00 | 2.19 |

Energy calculations were made for the conditioned room within a room on the basis of the Porkka modular cold room model 14.7A having external dimensions 2,700 mm x 3,300 mm x 2,100 mm and for the kit cool room on the basis of the Porkka, model C5.0A, net capacity 2,500 L, that maintain temperatures between 2°C and 23°C, providing both heating and cooling. Table 4 shows that the energy efficiency of the room within a room solution for the region and the kit cool room solution for the district are the most efficient use of energy per volume of storage and have the least energy consumption per year.

**Table 4.** Energy use comparison of technically feasible solutions

| Solutions for region and district | | Energy consumption (kWh/year[a)]) | Indexed consumption (kWh/L/year) |
|---|---|---|---|
| | **Regional store (15,000 L)** | | |
| 3 | Continuous HVAC[a] | 19032 | 1.27 |
| 4 | Precision HVAC[a] | 21397 | 1.43 |
| 5 | Room within a room[b] | 3504 | **0.23** |
| | **District store (2,500 L)** | | |
| 3 | Continuous HVAC[a] | 19032 | 6.50 |
| 5a | HVAC and lab refrigerator[a] | 24558 | 9.82 |
| 5b | Kit cool room[c] | 2774 | **1.11** |

Notes:

a. Consumption data include retrofit insulation of ceilings and walls.

b. Data based on Porkka modular cold room model 14.7A having external dimensions 2,700 mm x 3,300 mm x 2,100 mm.

c. Data based on Porkka C5.0A, capacity 2.5 $m^3$.

Table 5 compares the costs of the feasible solutions and shows that the room within a room and the kit cool room solutions are both less costly to install than the other solutions and are the least costly to run. The installation costs are quoted by the United Nations Children's Fund supplier Porkka, Finland. However, similar solutions cooled by air conditioners and manufactured by ECI, Tunis, were quoted as 11,740 DT (-18.7%) and 8,640 DT (-21.1%), respectively, for the regional and district stores.

**Table 5.** Energy cost comparison of technically feasible solutions

| Solutions for region and district | | Installation cost (DT) | Operating costs | | |
|---|---|---|---|---|---|
| | | | Maintenance (DT/year) | Energy (DT/year) | Total costs (DT/year) |
| | **Regional store (15,000 L)** | | | | |
| 3 | Continuous HVAC | 8260 | 900 | 3288 | 4188 |
| 4 | Precision HVAC | 41288 | 1500 | 4174 | 5674 |
| 5 | Room within a room[a] | 14440 | 900 | 420 | **1320** |
| | **District store (2,500 L)** | | | | |
| 3 | Continuous HVAC | 6372 | 900 | 2931 | 3831 |
| 5a | HVAC and lab refrigerator[b] | 28855 | 900 | 2972 | 3872 |
| 5b | Kit cool room[c] | 10952 | 300 | 305 | **605** |

Notes:

a. Data based on Porkka modular cold room model 14.7A having external dimensions 2,700 mm x 3,300 mm x 2,100 mm.

b. Data based on Sanyo MPR410, capacity 1.4 $m^3$ x quantity 2.

c. Data based on Porkka C5.0A, capacity 2.5 $m^3$.

# Discussion

In common with many stores in other countries, the existing government buildings of the regional and district stores in Kasserine are unsuitable for storing medicines at CRT without retrofitting and additional equipment. Existing space-conditioning equipment in these stores, which is now used in extreme periods for human comfort only during the working hours, do not achieve CRT. Operating such equipment full time for CRT is prohibitively expensive, as this study shows. Many existing buildings will not efficiently use energy, some to the extent that they are not economically feasible as a host site for CRT.

Retrofitting these existing buildings to improve energy efficiency is complex, costly, and disruptive to ongoing activities. The customized nature of retrofit hinders the development of broad guidelines for converting existing spaces to CRT storage space. Older buildings built with little concern for energy conservation will require added insulation, reduced air infiltration, and control of both internal and external heat gains. Space-conditioning equipment may also require retrofit. Because the volume of CRT storage required will usually be less than the volume of an existing building, the investment to retrofit the building may not be economical. For these reasons, it is preferable to establish a new warehouse or to find a recently constructed warehouse meeting the volume and access needs of all stores of medicines, vaccines, and dry stocks which is constructed to high standards of energy efficiency.

New construction offers the opportunity to incorporate both energy efficiency and renewable energies into the design. CRT with little or even zero energy input can be attained if climate-sensitive design is applied. Zero-energy buildings exist and are increasing in number, and the CRT required range of 15°C to 25°C is quite similar to passive space conditioning design targets. The implementation of CRT for storage of medicines will benefit from the efforts of these pioneering designers developing low-energy solutions for homes and commercial buildings.

If new construction is not an acceptable option and existing buildings have to be used, insulated cool rooms need to be constructed within the current storerooms for large volumes and commercial or pharmaceutical refrigeration cabinets used for smaller volumes. Presently few products are designed for the 15°C to 25°C range of CRT. However, if the lower limit of CRT is reduced to 2°C, then heating would not be required wherever minimum ambient temperatures are between 15°C and 25°C.

Current prices are high for CRT equipment but are expected to fall with increased demand for CRT. If the existing building envelope is inefficient, then the cooling equipment will consume more energy by working harder. The most affordable retrofitting to increase efficiency is likely to be insulation of walls and ceilings and low-cost air-sealing techniques.

In the future, as some vaccines achieve greater thermal stability, vaccine products may start to be stored at the same CRT temperature range as medicines. In larger stores before palletized tertiary packing is broken down, this could result in the use by medicines and vaccines of shared cool rooms. However, as is now the case for vaccines and medicines stored at 2°C to 8°C, refrigeration cabinets in smaller stores are more likely to remain separate for stock management reasons.

# Annex 1. Packed volumes of CRT medicines in Tunisia

| Brand name of medicine | Pharmaceutical name | Dimensions of primary packing | Quantity of medicine per primary pack | Dimensions of secondary packing | No. of primary containers in one secondary pack |
|---|---|---|---|---|---|
| **Clomid** | Clomifene citrate comp 50 mg | 10/4.5/2.5 | 20 tablet | 48/23/21 | 160 |
| **Colchicine 1 mg** | Colchicine comp 1 mg | 13/2.5/5.5 | 20 table | 53/15/23 | 90 |
| **Collu hextril** | Antiseptic mouthwash | | | | |
| **Contrathion amp** | | 5/8/11 | 10 amp | 40/42/60 | 40 |
| **Cortinef cp** | | 3/3/7.5 | 20 | 19/19/8 | 36 |
| **Dakin cooper** | Sodium hypochlorite dilute solution us Ext 0.5 % | | Bottle 500 ml | 20/20.5/28 | 12 |
| **Desferal amp** | | 9.5/7/3.5 | Amp | 32/32/42 | 100 |
| **Diclofene sup** | | | 50 | 25/17/31 | 20 |
| **Didrogyl sol buvable** | | 4/4/8 | Bottle | 20/19/44 | 100 |
| **Dipen 300** | Diliazen hydrochride | 13/4.5/4 | 28 | | 586 |
| **Ecorex lait** | | 4/4/10 | Bottle ml | 36/20/19 | 50 |
| **Efferalgan sirop ped** | | | Bottle | 12/26/42 | 40 |
| **Erythro sirop** | | 4/6/13 | Bottle | 37/14.5/34 | 36 |
| **Erythro capsule** | Erythro | 9/9/5 | Capsule | 43/34/26 | 24 |
| **Fefol capsule** | | 12/2.5/4.5 | 30 | 39/23/24 | 108 boxes/cartons |
| **Fongysone suspension buvable** | | 9/4.5/4.5 | Bottle | | |
| **Furadoine** | | 8/4 | Bottle of 100 capsules | 46/45/32 | 500 bottle |
| **Indocid 50** | Indomethacin suppository 50 mg | 10/10.5/5.5 | 100 suppositories | 39/30/42 | 80 |
| **Indocid 100**<br>**Indopal 100** | Indomethacin suppository 100 mg | 5/10/10 | 100 | 50/55/23 | 100 |

| Brand name of medicine | Pharmaceutical name | Dimensions of primary packing | Quantity of medicine per primary pack | Dimensions of secondary packing | No. of primary containers in one secondary pack |
|---|---|---|---|---|---|
| **Glycerine sup nrs** | | 10/2/5 | 10 suppositories | 52/13/26 | 160 |
| **Gyno-pevaryl Fongicil** | Imidazole Ovule | 7.5/5/2 | 3 ovules | 26/17/27 | 120 |
| **Haldol Neurodol** | Haloperidol oral drops 0.2 % | 14/4.5 | Bottle | 15/25/52 | 45 |
| **Haldol** | Haloperidol amp inj 5 mg/ml | 9/10/2.5 | 5 amp of 1 ml | 47/22/27 | 120 |
| **Helmintox bottle** | | 3.5/4/8 | Bottle 2.5 ml | 22/25/40 | 68 bottles |
| **Helmintox cp** | | 2/4.5/11 | 3 cp | 23/26/38 | 200 |
| **Heptamyl** | | 3/3/9 | Bottle | 47/25/35 | 420 bottles |
| **Hypoten 100 cp** | | 2/5/10 | 30 cp | 30/20/40 | 24 |
| **Hypoten 50 cp** | | 2/5/10 | 30 cp | | |
| **Hymofer** | | | | | |
| **Lactulose** | | 5.5/5.5/17 | Bottle 200 ml | 18/24/35 | 15 |
| **Levotherox** | | 2/4/10 | 28 | 19/12/44 | 100 |
| **Lopril 25 cp** | Actopril 25 mg bt/500 | 11/8/6.5 | Cp | 42/39/29 | 66 |
| **Lopressor** | Vasocard lp 200 mg bt/60 | 9/7/6 | Cp | 33/25/20 | 36 |
| **Loxen injection** | Loxen inj | 11/10/2.5 | 5 amp of 10 ml | 40/60/28 | 180 |
| **Lt4** | | | | | |
| **Mercryl** | Antiseptic surfactant * sol us ext | | Bottle | 26/26/34 | 12 |
| **Methergin** | Methylergometrine maleate oral drops 0,25 mg/ml | 4/3/9 | 15 ml | 24/38/19 | 126 |
| **Modepar** | Modepar cp 100 250 mg | 5/5/11.5 | 100 cp | 25/28/28.5 | 65 |
| **Moditen** | Fluphenazine dichlorhydrate # tablet 100 Mg | 3.5/3.5/6 | 15 cp | En vrac | |

| Brand name of medicine | Pharmaceutical name | Dimensions of primary packing | Quantity of medicine per primary pack | Dimensions of secondary packing | No. of primary containers in one secondary pack |
|---|---|---|---|---|---|
| **Moditen** | Fluphenazine dichlorhydrate # tablet 25 mg | 3.5/5/11 | 30 cp | 21/39/39 | 90 |
| **Mycoheal sup gynéco** | | 2/5.5/6 | 3 | | 384 |
| **Myleran** | Busulfan # tablet 2 mg | 3.5/4/6.5 | 25 cp | En vrac | |
| **Natispray** | Trinitrine AER 0,3 mg | | | | |
| **Neo mercazole** | Carbimazole tablet 20 mg | | | | |
| **Neo mercazole** | Carbimazole tablet 5 mg | | | | |
| **Neuroleptil** | | 3.5/3.5/9 | Bottle 30 ml | 10/18/36 | 50 |
| **Nifluril sup 700** | | 3/6/8.5 | 8 suppositories | 13/31/43 | 9 |
| **Nimotop** | Nimodipine # tablet 30 mg | 7/4.5/4.5 | 30 cp | 27/37/22.5 | 84 |
| **Noradrenaline** | Noradrenaline (sans sulfites) # sol inj 16/8 mg/ml | 11.5/4/11.5 | Amp | 47.5/37/17 | 42 |
| **Noradrenaline** | Norepinephrine bitartrate # amp inj 8 mg | 10/10/4 | 10 amp | 36/17/37.5 | 51 |
| **Nozinan** | Levomepromazine tablet 25 mg | 8/10/17 | 600 cp | 36/24/43 | 24 |
| **Nozinan** | Levomepromazine tablet 100 mg | 8/10/17 | 500 cp | 36/24/43 | 24 |
| **Nozinan** | Levomepromazine oral drops 4 % | 4/4/10 | Bottle 30 ml | 16.5/21/21 | 40 |
| **Nozinan** | Levomepromazine amp inj 25 mg | 10.5/9/2 | 5 ampoules | 54/19/22.5 | 100 |
| **Nystatine cp** | Micostat suspension oral | | Bottle 30 ml | 44/24/36 | 100 |
| **Parlodel** | Bromocriptine methanesulfonate tablet 2,5 mg | 2/4/10.5 | 30 amp | 23/22/43.5 | 240 |
| **Phenargan amp** | | 2/9/10.5 | 5 ampoules | 20/22/55 | 100 |
| **Povanyl cp** | | | | | |

| Brand name of medicine | Pharmaceutical name | Dimensions of primary packing | Quantity of medicine per primary pack | Dimensions of secondary packing | No. of primary containers in one secondary pack |
|---|---|---|---|---|---|
| **Prepulsid** | Cisapride suspension buvable 5/5 mg/ml | | | | |
| **Primperan** | Primperan suppositoire | | | | |
| **Primperan (doperan)** | Metoclopramide dichlorhydrate amp inj 10 mg | 2/7.5/10 | 4 ampoules | 16/31/50 | 150 |
| **Pulmicort** | Budesonide # AER 0,5 mg/2 ml | 21/7.5/8 | Aerosol | 49/22/21 | 24 |
| **Rifadine cp** | | 12/4.5/7 | 30 cp | 24/25/37.8 | 50 |
| **Rifacine collyre** | | 8/3.5/6 | Bottle of 10 ml | 36/37/48 | 320 |
| **Risordan cp** | Pensordil tablet | 11/4/2 | Cp | 45/22/21 | 220 |
| **Rhuta sup** | Ketoprofene 100 mg | 3/5/9.5 | 10 sup | 25/10/31 | 56 |
| **Rythmodon 100 mg** | | 13/2/5.5 | 40 cp | 24/52/15 | 90 |
| **Salbutamol sirop** | Salbutamol | 5.5/5.5/12.5 | Bottle of 120 ml | 33/25/22 | 48 |
| **Suprazone pd** | Dexamethazone pommade | 2/3/11 | Tube | 24/24/26 | 216 |
| **Temesta 2.5** | | 2/6/10 | 30 | 24/18/52 | 240 |
| **Tienam** | Imipeneme /cilastatine (bag/fl 100ml) #* pdre inj 500 mg | 3.5/3.5/7 | 500 mg | 37/19.5/15.5 | 100 |
| **Thyro 4 0.1** | | 4/4/8 | 100 cp | 20/22/48 | 120 |
| **Un-alfa** | Alfacalcidol caps 1 µgr | 10/6/3 | 30 capsules | 85/82/120 | |
| **Unidex soludicadran** | | 18.5/8.5/5 | 50 | 39/16.5/44 | 30 |
| **Un-alfa** | Alfacalcidol caps 0,25 µgr | 3/6/910 | 30 | 85/82/120 | |
| **Vagilen gynéco** | | | 10 | 52/13/26 | 100 |

| Brand name of medicine | Pharmaceutical name | Dimensions of primary packing | Quantity of medicine per primary pack | Dimensions of secondary packing | No. of primary containers in one secondary pack |
|---|---|---|---|---|---|
| **Vancocine** | Vancomycine chlorhydrate # pdre inj 500 mg | 3/3/7 | 500 mg | 44/17/34 | 280 |
| **Vasocarde 200 mg** | | 5.5/7/9 | 60 | 9/15/20 | 8 |
| **Ventoline** | Salbutamol AER 100 µgr/inhl | 5/10/3.5 | 100 µGR | 28/22/42 | 120 |
| **Vitamin c** | Vitamin C | 12/10/8 | 500 cp | 42.5/35/26 | 33 |
| **Xylocaine 5%** | | 4/4/8 | Bottle of 24 ml | | 80 |
| **Xylocaine 2%** | | 3.5/5/17.5 | Tube | 23/19/42 | 48 |
| **Xylocaine adrenaline** | Lidocaine chlorhydrate/adrenaline 400 | 16.5/6.5/7 | 10 | 30/30/30 | 32 |
| **Xylocaine adrenaline** | Lidocaine chlorhydrate/adrenaline 200 | 16.5/6.5/7 | 10 | 30/30/30 | 32 |
| **Zinnat** | Cephalosporine second generation Pdre inj dos.faible | 5/7/3 | 250 mg | 50/19/23 | 180 |
| **Zinnat** | Cephalosporine second generation Pdre inj dos.fort | 5/7/3 | 750 mg | 50/19/23 | 180 |
| **Syringes 2 cc** | Syringes 2 cc boxes of 100 | 31/17.5/29 | Accessory | 53/31/33 | 10 boxes of 100 syringes |
| **Syringes 5 cc** | Syringes 5 cc boxes of 100 | 21/12/21 | Accessory | 60/23/43 | 10 boxes of 100 syringes |
| **Syringes 10 cc** | Syringes 10 cc boxes of 100 | 42/14/14 | Accessory | 66/28/43 | 10 boxes of 100 syringes |