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# PRINCIPLES OF RURAL HOSPITAL DESIGNS

## Recommendations on NHS Design Standards

### **Abstract**

This document briefly outlines the summary of recommendations put forth by the PNG Society for Rural & Remote Health on specific National Health Service Design Standards

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**PNG Society for Rural & Remote Health**  
*Reaching & Serving the Rural Majority*

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## Principles of Rural Hospital Facility Design

### Introduction

The National Health Service Standards is a 'a blueprint for providing safe, quality health services as required by the National Health Plan 2011-2020 to transform our health system'. It is mandated by the National Health Administration Act (1997) and hence, requires that all stakeholders, including churches and private sectors, adhere to the standards developed for PNG.

One of the three major purposes of the NHSS is to *provide best practice for health care facility designs for all capital projects* which will ensure clinically safe and efficient facility for delivery of healthcare. But all implementers know that not all standards can be uniformly applied to all facilities to ensure the same quality of safety and efficiency. This is especially true with design standards - one standard design cannot be uniformly applied to all facilities considering their respective challenges. In the line of duty, the standards become burdensome at times for the implementer. They 'have not been widely implemented because of complexity of detail and missing technical advice for operationalizing local implementation."<sup>1</sup>

### Purpose

The guidelines, or recommendation contained herewith are compiled by the PNG Society for Rural & Remote Health during the 2022 Annual Rural Health Speciality Conference. The theme of discussion was "*Rural Hospital Designs - should there be a minimum standard?*" These recommendations are **best-practices** based on years of experience working in rural hospitals, and supported by evidences from recent researches.

This document outlines the principles of best practice to consider when designing rural hospitals. It is based on years of experience working in rural hospitals, and supported by evidences from recent researches. It serves as recommendations to guide members of The Society in their plan to improve facility design in their respective facilities.

The Society does hope too, that the Facility standards branch of the Medical Standards division will consider the best-practices outlined here. Minimum standards are a dynamic thing, and should not be too rigid, or too specific. Furthermore, they should be periodically reviewed and the process to review them, particularly when it concerns rural hospital designs, must involve input from the PNG Society for Rural and Remote Health.

### Principles of Best Practices

#### A. Process of Review & Planning

Regarding the process of review of design standards for rural hospitals, it is generally recommended that:

- a. Extensive consultation with relevant stakeholder is essential, including consultation with the local communities through their respective leaders.
- b. Of particular importance is to consult medical professionals serving in rural areas; no standards regarding design should be developed based solely on advice from overseas-based or urban-based consultants who have very little 'feel' of the rural challenges.
- c. It is essential to have a Master Plan when embarking on building a new rural hospital or upgrading an existing one. The plan should include service infrastructure, accommodation, energy plan and proper waste management. A Master Plan should capture all the necessary infrastructure development to ensure provision of all roles delineated for rural or district hospitals. It is important that the plan outlines Phases of development (which infrastructure to construct first, next, etc..) and it is advisable that construction is done phase by phase.

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<sup>1</sup> Schuele E, MacDougall C (2022) The missing bit in the middle: Implementation of the Nationals Health Services Standards for Papua New Guinea. PLoS ONE 17(6): e0266931. <https://doi.org/10.1371/journal.pone.0266931>

- d. Specialist Medical Officers (Rural Health) should be involved in reviews and planning to represent The Society or be consulted in any reviews required by the Health Department regarding rural hospital design standards.

The Rural Medicine speciality is undeniably growing fast and is a specialty with the right skill-mix to convert a rural facility into a Bellwether hospital, and create a centre for effective provision of primary rural health services and secondary curative health services. It is time that we have a representation in the National Department of Health, either by way of having a Chief Rural Physician or involving a specialist in all relevant NDoH consultations.

### B. Biomed Equipment

Regarding Biomedical Equipment for rural hospitals, The Society opts to make general recommendations rather than specific ones:

- a. Rural hospitals should aim to procure equipment that are not too sophisticated but simple enough to maintain.
- b. Biomedical equipment for rural hospitals should be Portable and Affordable machines (low cost)
- c. Biomedical equipment for rural hospitals should work on less power (be power efficient).
- d. It is important to consult other stakeholders, including those working in rural hospitals when procuring biomedical equipment for rural hospitals.
- e. Equipment must be meet relevant safety standards
- f. Procure biomedical equipment that can be maintained by locally trained technicians. This should be a rule of thumb. It can be very costly to engage overseas technician to service the equipment.
- g. All x-ray staff can have radiation badge only if there is good pathway for badge to be read; there is no point for the badge if there is no easy pathway for reading or if it cannot be read.
- h. A machine that is performing well in one hospital can be recommended to other hospitals to procure. Similarly, a procuring or manufacturing company with better deals can be recommended within the Society.

### C. Lighting

Regarding lighting in rural hospitals, The Society recommends that:

- a. Design should promote more natural light (sunlight) as possible. Skylights must be considered in the design.
 

A study in Pakistan identified the determinants by which sunlight promotes human health, and made the conclusion that since adequate and appropriate exposure to natural light is promotes health and wellbeing of staff and patients, natural light should be incorporated into lighting designs in healthcare settings.<sup>2</sup> A further benefit to note about natural lighting is that it is delivered at no cost and in a form that people prefer.
- b. Avoid building plans with large proportion of windowless rooms. Design suitable building orientation to provide access to natural lighting to improve patient and staff healthier outcomes
- c. Where artificial light is used, lights that save energy (LED lights) should be used as much as possible.
- d. Open planning (less small rooms) is preferable. More room means more light in each room, which means more energy is used.

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<sup>2</sup> Manzoor, Shaikh & Seung, Park. (2013). An Architectural Study on the Relationship of Skylight and Patient's Satisfaction at the Ambulatory day careward in Agha Khan Hospital Pakistan. *Nursing and Health*. 1. 21-30. 10.13189/nh.2013.010202.

#### D. Energy (power)

Regarding energy sources for rural hospitals, the Society recommends that:

- a. Due to location of PNG to the equator, any new facility should be designed with a new stand-alone solar power system. These has the advantages of:
  - i. Minimal maintenance
  - ii. No landowners problems
  - iii. Clean energy
- b. Other clean energy system can be considered based on local climate or geographical conditions

#### E. Water Supply

With regards to water sources for rural hospitals, the Society recommends that:

- a. All new facilities should have maximized rain-water harvesting designs. This should be an important component of master planning and design
  - i. Big tanks (100 - 150 000 L tanks)
  - ii. Create water bank
- b. Design of buildings should consider special designs that don't necessarily require electricity to cause flow throughout the facility. Designs using the Siphon principle have been used successfully in some rural facilities.

#### F. Ventilation

Regarding ventilation in rural health facilities, the Society promotes these basic principles:

- a. Ensure that facility design promote more natural air circulation.
- b. Design should promote tall roof space, or have high ceilings. It is even adequate to have no ceilings.

A scoping exercise reviewing design strategy for low-energy ventilation and cooling of hospitals recommended that up to 70% of net floor area in small to medium facilities can be naturally conditioned (ventilated)<sup>3</sup>.

- c. Yet, care must be taken in the design to avoid air-borne cross-infection within clinical sections of the hospital. E.g. design must block off natural circulation from TB ward into other sections.

#### G. Space & Flow of Services

The following principles of spacing in the rural hospital is promoted by the Society.

- a. All Waiting Areas, and the Out-Patient department should be without walls. The advantages of such design are:
  - i. Better infection control
  - ii. Better ventilation
- b. Labour room should be more spacious (should be able to fit in two stretchers)
- c. Corridors should be designed to have windows or better ventilation and natural lighting. Avoid designs of closed off corridors.
- d. Consider health training and staff meeting rooms in the designs.
- e. Related Services to be in close proximity to each other. In particular, the Labour Ward, CSSD and Operating Theatres should be in close proximity.
- f. Generally, diagnostic services and the administration complexes must be located between in-patient and outpatient locations

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<sup>3</sup> C. Alan Short & Sura Al-Maiyah (2009) Design strategy for low-energy ventilation and cooling of hospitals, Building Research & Information, 37:3, 264-292, DOI: 10.1080/09613210902885156

H. Interior Designs & Layout

- a. Bathroom & shower room door must be wide enough to accommodate two people (patient & guardian), particularly in sections where ambulatory support is required.
- b. Nursing stations configurations must promote high visibility of patient, reduced travel distance and less interruptions. Below are configurations with the pros and cons<sup>4</sup>.

Table 3 Diagrams and advantages and disadvantages of selected layout options

Layout Option	Description*	Advantages	Disadvantages
<b>Acute Care or Inpatient Unit Layout Options</b>			
Racetrack layout		<ul style="list-style-type: none"> <li>• Supports centralized and decentralized configurations</li> <li>• Provides entry of natural light</li> <li>• Enables visibility between team stations and patient rooms</li> </ul>	<ul style="list-style-type: none"> <li>• Misplacement of support equipment may compromise the benefits of this layout</li> <li>• Optimization of the level of centralization of support equipment and nurse stations is required</li> </ul>
Y-shaped layout		<ul style="list-style-type: none"> <li>• Suitable for units with a large number of patient rooms</li> </ul>	<ul style="list-style-type: none"> <li>• Low visibility from the central nurse station</li> </ul>
Radial layout		<ul style="list-style-type: none"> <li>• Associated with shorter overall nurse walking distance</li> <li>• Allows high visibility from the central station to various rooms</li> </ul>	<ul style="list-style-type: none"> <li>• May contribute to more interruptions</li> <li>• Suitable for smaller units</li> </ul>
<b>Emergency Department</b>			
Cellular design		<ul style="list-style-type: none"> <li>• Has the potential to reduce patient waiting time in ED as it encourages dedicated staff members located in redundant cells</li> </ul>	<ul style="list-style-type: none"> <li>• Not appropriate for long buildings</li> <li>• Requires duplication of activities and staff for each of the cells</li> <li>• Requires significant changes to ED processes and staffing models</li> </ul>
<b>Clinic Layout Options</b>			
Office as Exam Room Model		<ul style="list-style-type: none"> <li>• Allows private offices for providers</li> <li>• No changes to workflow are required as it supports traditional clinical workflows</li> </ul>	<ul style="list-style-type: none"> <li>• Limited team interaction</li> <li>• High patient walking distance</li> <li>• Higher patient waits times</li> </ul>
Co-located staff with a common hallway		<ul style="list-style-type: none"> <li>• Nurses and doctors are adjacent to each other</li> <li>• Shown to reduce walking for patients</li> <li>• High level of staff interaction</li> </ul>	<ul style="list-style-type: none"> <li>• Privacy concerns as patients may see/hear staff conversation</li> <li>• Requires cultural changes for staff to allow for a shared workspace</li> </ul>
On-stage/off-stage		<ul style="list-style-type: none"> <li>• Shown to promote staff interaction, co-awareness, co-visibility, reduce walking distances for staff and patients, and increase throughput</li> <li>• Separates staff work areas from patient circulation</li> </ul>	<ul style="list-style-type: none"> <li>• Requires more square footage which increases construction cost</li> <li>• Requires cultural change to allow for shared workspace</li> <li>• Privacy concerns if interiors did not support noise isolation</li> </ul>

\*Images courtesy of EwingCole

<sup>4</sup> Halawa F, Madathil SC, Gittler A, Khasawneh MT. Advancing evidence-based healthcare facility design: a systematic literature review. Health Care Manag Sci. 2020 Sep;23(3):453-480. doi: 10.1007/s10729-020-09506-4. Epub 2020 May 24. PMID: 32447606.

## I. Waste Disposal

With regards to waste disposal in rural hospitals, the following principles are promoted by the Society:

- a. Incinerators must come with associated funding to maintain
- b. Volume of medical waste should be recorded by each facility
- c. There must be staff toilets in all major sections.
- d. Toilet facility must be use friendly for the respective rural community, while still observing standards.

We have observed that a pour flush septic system has low life expectancy in a rural setting and that is primarily due to the unfamiliarity of the rural populace in using the system. Too often, leaves, sticks, carboards and even pieces of cloths are used to wipe, leading to frequent blockages of the system. Hence, the Society recommends that toilet facilities in the rural facilities should be of a special design that is user friendly and still maintains acceptable waste disposal guidelines.

## J. Operating Theatres

Operating theatre providing operative management of cases are one of the services distinguishing rural hospitals from other rural health facilities. Designs of the rural hospital operating theatre should observe the following principles:

- a. Given that there is no concrete evidence to support closed laminar flow ventilation, designs should allow more natural ventilation. A systematic review and meta analysis published in *The Lancet* interpreted that available evidence shows “no benefit for laminar airflow compared with conventional turbulent ventilation of the operating room in reducing the risk of SSIs (surgical site infections).”<sup>5</sup>
- b. Aircon has less benefit and is high cost and is discouraged for rural hospitals. Reliance on aircon leads to great difficulty when machines break down.
- c. There should always be a stand-alone back-up solar power supply for the theatre for emergency use. This may be a 12V or 240V system.

## K. Staffing Accommodation

- a. All planning should consider and include sufficient staff accommodation
- b. Staff ceiling for district hospitals can go up to 200, requiring this much houses. Hence, planning for accommodation is crucial to be including in the master plan.

## L. Mortuary

- a. Should be considered for the district hospital (depending on geographical location) and the presence of a mortuary attendant

## M. HeliPad

- a. Consider this if no other area available for landing

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<sup>5</sup> Bischoff *et.al.* Effect of laminar airflow ventilation on surgical site infections: a systematic review and meta-analysis. *TheLancet* 2017; Vol 17, ISSUE 5, P553-561, MAY 2017 ([https://doi.org/10.1016/S1473-3099\(17\)30059-2](https://doi.org/10.1016/S1473-3099(17)30059-2))

## **General Comments**

- a. Due to the complexity of the layout design process and the high number of constraints that exist, a single approach may not be sufficient; hence, there is a need for multiple approaches that act as a solid framework for the design process. A single rigid design pushed down from the Standards Authority without facility staff input should be discouraged
- b. Minimum standards should be considered a guide and something to work towards to, but should never lead to decreased services. For example, a lab or theatre or X-ray department should never be closed down citing reasons as “low compliance to standards” unless there is a readily accessible alternative in place. Accreditation surveys should aim more towards identifying gaps to improvement rather than identifying reasons to halt services.
- c. Infrastructures designs should be flexible as much as possible - ie. Minimum standards should not be too philosophically rigid but allow for new and local ideas or input. Medical officers based in, and actually using the rural facilities are a important voice to listen to in terms of usability of various design features. It is important that the NHSS teams include them in consultation processes.



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