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The Importance of Maintenance & Repair in Health Facilities of Developing Economies

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Maintenance and repair: a non-issue

Despite numerous weak points, functional areas like maintenance & repair are firmly integrated into the management of health facilities in industrialised countries. Within our own systems, they have long since become a matter of fact. No one would seriously question the worth of systematic maintenance and repair. Consequently, this is not (or is no longer) one of those issues that would generate much attention outside of hospitals. Indeed, this can also hold true inside of such establishments, when the tranquillising effect of the more or less well-functioning daily routine keeps administrators from recognising the technical service's need for permanent support. All that can really disturb this peace is a combination of lessening financial leeway and, from the standpoint of the medical staff, a loss of quality. Usually mechanisms designed to enhance financial and technical efficiency, e.g., through optimised quality management, come to bear in industrialised countries.

Maintenance & repair is a non-issue in emerging countries, too, where it falls prey to a sort of unholy alliance among:

- a general scarcity of resources
- indifference on the part of public health officials
- indifference on the part of donors
- weak health management
- lack of support by private industry
- lack of know-how.

Health facility administrators argue, for example, that the money does not even suffice to pay for the needed drugs and medicine. So how are they supposed to put up additional funds for repairs? The donor community, they hope, will take care of the replacements. Often enough, they actually do so without comment. Either the donors fail to recognise the maintenance &

repair problem, or they bemoan the situation - and declare maintenance & repair to be a typical partner contribution. The partners, though, have neither the financial means nor the know-how to establish their own efficient maintenance & repair infrastructure. The fact that most countries have a centralist way of handling health management is an additional problem. Despite persistent efforts by the partner countries to dismantle such paternalistic structures, the progress they have made in the course of customary monitoring periods lasting 10 to 20 years must be termed modest. On the other hand, developments in the establishment of district health systems are giving grounds for hope. Private-sector industry, particularly in the poorer developing countries, has not yet been able to adopt a constructive attitude toward public health services. Only a few major suppliers provide after-sale services - frequently of dubious quality. In large sections of the developing world, the fully understandable desire to turn a profit leaves companies little choice but to attach primary importance to the sale of their products. African countries account for only about 1 % of the global medical equipment market [1]. This hardly offers much incentive for suppliers to provide service structures, much less to develop "appropriate technology". Likewise, health care personnel often display an underdeveloped interest in such matters. All in all, the users of medical equipment (normally physicians and nurses, of course, but also cleaning personnel) can be assumed to cause, either directly or indirectly, two out of every three equipment breakdowns. This is due in part to a lack of know-how, but also to socio-cultural factors in combination with primarily hierarchically defined styles of leadership that engender indifferent behaviour: lack of initiative, deficient sense of responsibility for public property and, finally, an underdeveloped sense of ownership. And it must be noted that this, in combination with underpayment, can end in corruption. It thus happens that funds allocated for maintenance and repair are preferably invested in contracts with private-sector service providers - as opposed to the facility's own maintenance & repair unit - in anticipation of personal rewards (quid pro quo).

In developing economies, maintenance & repair poses special demands, but these usually go unheeded. As a result, many rural and urban health facilities are in altogether catastrophic condition.

The consequences of deficient maintenance & repair

It is plausible to assume that underdeveloped technical management can have negative impacts on morbidity and mortality ratios. Due, however, to a lack of pertinent data and to the complexity of the causalities, it would hardly be possible, except perhaps in some isolated cases, to quantify such effects. In actual fact, though, hospital buildings and their operational equipment are mostly in a state of disrepair. Their doors and windows are

broken or missing. Their walls and floors exhibit carcass qualities, and their roofs let more rain in than they hold back. All this is compounded by such tropics-specific problems as the danger of ceilings collapsing under the weight of droppings from swarms of bats that like to settle in among the buildings' dilapidated rafters and joists. Water is also an enormous problem. Often, there is no running water at all, or only at irregular intervals. The available water is often contaminated with microbes and/or toxic substances. This, in combination with the neglected buildings, can render the sanitary facilities unusable. Ultimately, such circumstances lay the groundwork for generally untenable hygiene conditions that put both the health care staff and the patients in jeopardy. And this is happening at institutions which, particularly in rural areas, are supposed to teach people how to stay healthy. In a study of six health care facilities in Dhading District/Nepal [2], for example, five were found to have close to no water. None of them had either a fairly reliable supply of power or an organised form of waste disposal. In five of the six facilities, the hygiene situation could only be described as catastrophic.

Things are no better in the medical equipment sector, either. Defect rates estimated for developing countries go as high as 80 % [3], though this may not always be apparent at first glance. One study of 14 health care facilities in Malawi [4] documented the following situation: of the 443 items of equipment encountered, 77 % were at least in workable condition. However, 72 % of the equipment was found to be obsolete and therefore in need of replacement. The overall quantity of equipment items was conspicuously low for such a large group of health care facilities (three district hospitals and 11 health care centres). An interpretation of this data leads to what one might call "equipment Darwinism": survival of the fittest! This is a frequently observed phenomenon, one which often goes hand in hand with a peculiar preference. What little money is available for maintenance & repair goes into the X-ray equipment. Why? For one thing, "modern" diagnostics is overvalued and, for another, the equipment in question generates income ("overprescribing"), thus imposing an additional financial burden on the unknowing population.

In the final analysis, such a situation produces low-quality health care, low utilisation rates due to loss of trust, low income (in the form of health care fees) for the hospitals, and demotivated health care personnel. In view of the developing countries' still-precarious public-health indicators, including a 1995 mortality rate of some 197 per thousand births among children below five years of age in Western Africa [5] (compared with seven per one thousand in Germany) - measures must be taken to improve the situation regarding technical expedients for the health care sector.

While regular, systematic maintenance & repair with a definite preventive bias may not be able to remedy or alleviate all such problems, the past 15 years have proved quite clearly that a preventive maintenance strategy does work well.

The planned preventive maintenance concept

Strategy:

Maintenance & repair in the public health sector pursues the following objectives:

1. to guarantee the required quality of health care to the extent that it depends on technical functions, and
2. to optimise the economy of use of buildings, building services and equipment.

Basically, there are two different forms of behaviour in connection with maintenance & repair. One of them is to wait until a technical function has failed or suffered a loss of availability. For example, the ambulance's faulty differential will not become eligible for repair until it has jammed up altogether. The leaky gasket is accepted in the hope of its not making that much difference, anyway. This way of thinking is understandable to a degree. To replace the gasket is to spend money that is difficult to find in a notoriously empty cashbox. In the past, the administrative personnel has hardly been sensitised with respect to such matters, because the economic-interdependencies of maintenance and repair under conditions prevailing in newly emerging economies are still extensively unknown.

Based on the hypothesis that a pro-active approach to maintenance helps minimise expensive repairs, what is referred to as planned preventive maintenance (PPM) is gaining ground. The essential elements of the PPM strategy are:

- periodical inspections
- periodical maintenance
- analysis of maintenance-relevant data in order to react properly to undesirable developments.

The inspection and maintenance activities are conducted according to a fixed time + personnel schedule on the basis of checklists and type-specific procedures. The inspections are supposed to determine whether or not the actual status of a technical function differs from its projected status. Maintenance is intended to prevent premature wear and malfunctions (e.g., by keeping therapeutic equipment clean and calibrated, with tight seals

and gaskets, etc.). Guaranteed equipment safety, particularly in the electrical sense, is a priority consideration in this sector. The evaluation of documented maintenance data is also of major importance with regard to quality assurance. One objective of such activities is to identify any relevant peculiarities among certain types of equipment. If, for example, the (emergency) generator breaks down frequently, it could be due to a recurrent operator error, and the problem could be solved by calling the responsible individual's attention to the problem and modifying the operation instructions accordingly.

Such measures should be supplemented by appropriate training for the users of medical equipment. They should be taught the basic functions and uses of such equipment and, above all else, how to operate such appliances and keep them in good repair. The latter, of course, comprises mainly minor maintenance and cleaning activities on the part of the user. Social constraints, however, often prevent medical personnel from cleaning their equipment themselves. In such cases, it could be advisable to provide the cleaning personnel with the requisite additional training.

Obvious and convincing as the described approach may be, it is not possible to completely avoid the need for repairs. Nevertheless, a prevention-oriented system can be expected to require mostly simple repairs that can be attended to by in-house technicians and tradespeople.

Implementation:

In implementing a PPM system, or any other kind of maintenance & repair programme, those involved often find themselves disagreeing on ideological aspects of how to get the job accomplished. They split up into two camps. One camp believes in the now-popular "out-sourcing approach", the main advantage of which is to reduce the administrators' workload. The other camp is confident that the in-house technical services department can take care of everything itself. This latter attitude is presumptuous and bound to be as expensive in the end as it would be to call in an outside service enterprise for the entire lot of work. Experience shows quite clearly that only a well-balanced combination of in-house and external maintenance & repair services will lead to results that are both technically and financially satisfactory.

Experience also shows that the abandonment of centrally structured maintenance services has worked well. Big, expensive urban workshops designed to serve an entire country are being replaced by small, modest workshops at the district and province levels. This model is in line with a general policy of decentralisation that most emerging countries have adopted

for their health service systems. Decentralisation is no cure-all, of course. The central authorities - normally the ministry of health - must assume steering and monitoring functions, though this has not yet advanced very far in the maintenance and repair sector. Such important matters as the standardisation of medical equipment are therefore being left solely to the doctors and administrators. Even the implementation of district-level maintenance can be problematic. Efficient maintenance depends on efficient health management. If there is something wrong with the personnel, financial or logistical management, the maintenance & repair effort is bound to suffer as well, because it is reliant on such functions. Consequently, maintenance & repair must be integrated into the respective management. At the district level, this would translate into representation on the district management team. This applies analogously to hospital management and to the provincial / regional level.

The main physical requirements of a maintenance services unit are:

- personnel
- workshop, tools and machinery
- spare parts
- transportation
- recurrent expenditures

The minimum requirement for a district workshop (normally attached to a district hospital) is a polyvalent technician. The term "polyvalent" is intended to express this level's need for a specialist with a broad range of not necessarily finely honed skills. In that connection, "janitors" come to mind as a typical example. Also referred to as building custodians, these staff is responsible for keeping watch over "their" property and reliably attending to all its numerous little day-to-day chores. According to an analysis of maintenance & repair tasks at typical health facilities in Tanzania [6], some 90 % of all such work is of a simple, trivial nature. This includes the range of preventive maintenance. Only more complicated repairs require the assignment of more specialised personnel, e.g., from the private sector. For health facilities below the hospital level, it is envisioned that one member of the staff be designated, and duly trained, as the facility's maintenance officer. This person's duty scope would include only the least complicated of preventive measures, minor repairs and coordination with the workshop at the hospital.

The workshop itself should have between 30 and 60 square meters of floor space and a storeroom, e.g., in the form of a used container. The workshop equipment - rudimentary machinery, hand tools and a basic stock of consumables - would cost about US$ 10 000.

The replenishment of spare parts and such can be difficult. Consequently, appropriate measures should be taken, perhaps by the ministry of health, to improve the logistics. Medicine procurement programs can also be tapped into for such purposes.

Since a workshop at the district level (and, even more so, at the provincial level) must take care of lower-level health facilities as well as the hospitals themselves, some means of transportation will also be required. This is not to say that a special vehicle has to be procured for maintenance purposes. Normally, suitable management of the available motor pool, together with the use of public transportation systems, should be sufficient. Mobile workshops should be rejected on the grounds of their provably high follow-on costs.

Only by way of conscientious documentation of all cost factors is it possible to determine the precise current expenditures of maintenance and repair service units. The following rough figures can be assumed for initial planning purposes:

- approx. 1- 2 % for buildings
- up to 3 % for building services (utilities)
- approx. 3 % to 8 % for medical equipment, depending on its complexity (assumed average: 5 %).

These figures apply per annum as fractions of the new-acquisition value. They cover all expenditures, including outlays for personnel, material, transportation, utilities and workshop depreciation. In actual practice, it can be quite difficult to get all of these costs covered. In reality, most public health systems in Africa allocate less than 1 % per annum for maintenance expenditures. The increasing financial autonomy of health facilities does alleviate the problem somewhat. Already, some countries are paying over fixed amounts of income from medical treatment fees and the sale of medicine to help cover district-level maintenance expenses. In Kenya, for example, the ministry of health has ordered this to be a minimum fraction of 25 %.

The cost issue ties directly into the question of which economic impacts can be expected to emanate from rationally managed maintenance efforts in public health facilities. Despite some initial methodological difficulties, it is now possible to demonstrate their macroeconomic and microeconomic efficiency.

The economic impacts of preventive maintenance

As already mentioned, there can be no doubt about the benefits of maintenance in the public health facilities of industrialised countries. As a result, few, if any, investigations have been conducted concerning the direct monetary advantages to be gained from maintenance. Only comparative studies are to be found:

One study of surgical aspirating pumps in Germany impressively documented the effects of a change in maintenance strategy [7]. Switching from an outsourcing basis to in-house personnel reduced the cost of maintenance & repair by some 35 %. Then, PPM was introduced, and the costs shrank another 35 %. As a spin-off effect, the average downtime also dropped by nearly 30 %. A survey conducted in El Salvador [8] showed that such cost effects also apply in developing countries. Dispensing with PPM and returning to an exclusively repair-oriented approach made the costs jump by about 103 % in the course of two years!

As impressive as such comparisons may be, they fail to bring across the real economising potential of preventive maintenance. What is needed is a comparison between the total cost of a given set of equipment or structures with and without maintenance. Just such an instrument has now been developed [9]. Its point of departure is the fact that PPM prolongs the life expectancy of such utility items as, say, a washing machine. In time, use of the machine becomes less expensive, because replacements are required less frequently, thus disburdening one's own budget (or that of a donor, whose health-care contributions must also be accounted for!). For a washing machine with a purchase price of US$ 4 000, this means that maintenance can extend its service life from roughly five years to eight, whereby the cost per annum drops from US$ 800 to about US$ 500, for annual savings of approximately US$ 300. By contrast, the average cost of maintenance can be pegged at a mere US$ 120 per annum. Even this simplified model calculation suffices to illustrate the immediate economising effect.

Taking as an example the entire building and equipment inventory of the Cote d'Ivoire Health Ministry (modified as per [9]), a model calculation of its 1998 economising potential was performed an the assumption that maintenance increases life expectancy by 50 % on average (figures in USx10^6$):

Economising potential of maintenance in Cote d'Ivoire

	Buildings	**Equipment**	**Total**
Replacement costs	53.36	47.67	100.93
Maintenance costs (buildings 1 %, equipment 5 %)	0.53	2.38	2.91

	Buildings	Equipment	Total
Gross savings (for a 50 % to 100 % increase in life expectancy)	0.89	4.77	5.66
Net savings (after subtraction of maintenance expenditures)	0.36	2.39	2.75

Table 1

Thanks to maintenance, the provision of buildings and equipment for Cote d'Ivoire's public health system costs nearly 2.7 % less per annum. This equates to savings of US$ 2.75 million. At the same time, the quality of health care can expected to increase, and its positive effect on utilisation rates helps increase the health facilities' revenues.

The methodology for assessing the economic efficiency of maintenance expenditures is in place but not yet practice-proven. Nor has the financing of such expenditures yet been backed up by pertinent calculations. Even if these economic-efficiency arguments are enough to convince the public health authorities in a given developing country, they will not necessarily be able to easily mobilise the resources it would take to establish and support effective maintenance services.

What to do?

Obviously, even the most thoroughly convinced developing country will still require help from the donor community. And any support provided must go beyond the first dimension: maintenance-specific projects alone will not suffice; the assistive approach must also deal with maintenance per se within the context of conceptional and material development of the primary health care sector. This will include both technical assistance and the assumption of costs incurred for the establishment of workshops and/or corresponding management functions at all levels. Despite the drawbacks of assuming the partner's recurrent expenses via financial and technical assistance, the donors should still consider the worth of contributing to a basket fund devoted to helping particularly disadvantaged countries finance their maintenance activities.

Such financing must also be provided for action research measures geared to the design and development of new local financing options for maintenance expenditures. Among others, most health-sector projects sponsored by the German Federal Government through the *Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH* are working along those lines. It would be good to see this take on a broader scale, but that will require continued, intensive, persuasive efforts among the developing countries as well as all major

national and international development aid organisations and expert bodies. It is to be hoped that this event can contribute toward that end.

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