

► Keywords

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Relevance of economic efficiency analysis of decentralized and centralized reprocessing of patients' beds in a maximum-care hospital

Summary

Background and objective: As one aspect of technical hygiene whose realisation is currently a topic of debate, the reprocessing of beds should be analyzed also from the economic perspective, because up to now no thorough cost analysis exists. In addition to statements on output the input is measured by a cost analysis to identify the procedure with the best cost:benefit ratio. Moreover, options for cost reduction based on the cost-cutting potential of a given procedure are emphasized. Additionally, in terms of bed reprocessing, aspects for continuously reducing costs should be indicated.

Method: The three types of reprocessing performed in Germany were analyzed: decentralized, centralized-manual and centralized-mechanical reprocessing of beds. First, a literature review was accomplished to determine the legal requirements. The analysis of the current situation was based on plant-site inspections at manufacturers and in hospitals, interviews with operators and persons responsible for various management areas. The cost calculation was based on the fictive description of a maximum provider. If possible, real data were utilised. The prices used refer to list prices without considering any kind of discounts.

Results: Expert opinions in medical hygiene show that each type of reprocessing leads to the necessary reprocessing result, for which the motivation of the worker performing the job is a requirement. The essential cost categories considered here are construction, investment, service and maintenance, material, operating resources, personnel costs, and bed-transport costs; however, every type of reprocessing affects different cost categories. Personnel costs encompass the largest share of the total cost of reprocessing (up to 89 %). In terms of bed repro-

cessing at a central facility, the personnel resources spent on round-trip bed transport are decisive. Relative to the centralized-mechanical processing, operating resources must be considered in addition to personnel costs as decisive for the total expenses (up to 42 %). With respect to cutting costs, personnel and operating resources includes the greatest potential. With identical reprocessing results, the costs for the central-manual or -machine reprocessing are greater than those of decentralized bed processing by about 2.9 and 4.5 times, respectively. **Conclusion:** In terms of both economics and medical hygiene, decentralized bed reprocessing has been shown to be suitable. Because personnel costs represent the greatest percentage of the total costs – independent of reprocessing method – potential savings of 61 % result if the most cost-effective qualification level, janitorial services, performs the work, given clear guidelines on the risk classification of the bed after patient release or transfer and the accompanying requirements for bed reprocessing.

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Introduction

In Germany, the current focus of health policy discussions is on, apart from quality and other aspects, how to finance the present and future healthcare system [1]. The main concern here is to limit investments for healthcare services on the basis of a broad social consensus. Under discussion are aspects such as the nature, scope and definition of medical services, the implications of solidarity and the role of the healthcare sector as an economic factor [2].

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Any discussion about financing the healthcare system must take account of continuous quality assurance where the provision of hospital services is concerned. Hospital services comprise primary and secondary services. Secondary services act as support mechanisms for the primary services and are inextricably bound up with the hospital production process. Technical hygiene services are classified as secondary services. The processes needed to render secondary services can in general be planned. This is also true in the case of bed reprocessing. Every patient admitted to hospital has a right to a clean disinfected bed that is made with fresh linen, protected by means of microbial-impermeable bedcovers and has been reprocessed using a wipe disinfection method [3,4,5,6]. Therefore bed reprocessing has cost implications, regardless of how it is performed, since it is a task that must be carried out for each and every hospital patient [4].

Based on an economic efficiency analysis, the following cost comparison is presented as a model for decentralised, centralised-manual and centralised-automated bed reprocessing while complying with the relevant hygiene standards. The mixed form of decentralised and centralised reprocessing shall not be considered in this cost analysis.

Hospital hygiene (infection control) constitutes a horizontal function that impinges on all medical disciplines [7]. Accordingly, as regards the positioning of hospital hygiene it must be concluded that, depending on the individual service, it can be provided where bed reprocessing is concerned both close to and far from the patient.

Bed reprocessing is explicitly regulated by Article 23 of the Regulation Governing the Establishment and Operation of Hospitals (Hospital Management Regulation - Krankenhausbetriebs-Verordnung-KhBetrvO) of 10 July 1995.

The hospital management bears sole responsibility for assuring and implementing hygiene-related conditions and measures. It must take all the necessary measures to assure the stipulated structural, process and outcome quality [8]. In terms of hospital hygiene, the highest management level determines the structural quality to be implemented as a guide to activities in all decision-making committees [9]. Furthermore, each profes-

sional group involved in planning hospital service processes bears personal responsibility for implementation of hygiene standards.

Methods

The aim of this analysis was to conduct a detailed study of the efficiency of the entire bed reprocessing services, bearing in mind that neither a uniform organisational form nor a uniform procedure has been defined for the bed reprocessing methods used. These are determined by the circumstances of the respective institution and are decided by the hospital authorities, the responsible bodies and by those entrusted with this task. However, electrically and mechanically operated hospital beds are defined as belonging to Class 1 of the Medical Devices Act [10], which is why a standard operating procedure must be set out for them in the infection control policy.

The currently prevailing situation was elucidated by inspecting the plant sites of the manufacturers of reprocessing equipment and hospital beds, inspecting the respective premises (including equipment /systems) in the hospitals, conducting interviews with manufacturers, operators and with those responsible for bed reprocessing systems in central bed reprocessing units as well as interviews with the persons responsible for such activities among the nursing, cleaning, delivery and collection services. Furthermore, documentation was inspected, various measurements carried out and an inventory taken of the existing technical fittings and equipment.

For the cost analysis all the following important cost categories were examined: personnel, investments, maintenance and repairs, materials, operating resources, construction as well as the costs incurred for transportation of beds. Cost calculation was based on comparable data related to the framework conditions for a fictitious description of a maximum-care hospital. As far as possible, real-life data were used. The prices included were based on list prices without discounts. The data material researched was compared and evaluated in respect of input and output. This part of the study was based on detailed interviews and input from management personnel from the following departments: technical hygiene, medical technology, hospital logis-

tics, purchasing office, facility management, construction and project management, finances /controlling and personnel management in hospitals.

Analysis of the structure of a maximum-care hospital

For the costs incurred for the bed reprocessing forms investigated, in particular for comparison of the results of the analysis, an acute maximum-care hospital was chosen as a fictitious example. The framework conditions of this maximum-care hospital were based on real German hospitals. The bed capacity is 1,240 beds as set out in Article 108/109 of Book Five of the German Code of Social Law (SGB V) with a capacity utilisation rate of 80 %. The total annual number of inpatients is 47,168.

The hospital to be studied is completely (100 %) in private ownership. The legal form is a company limited by shares, i.e. a private limited company.

1. Decentralised bed reprocessing

Based on identified partial steps of decentralised bed reprocessing and on the fact that these are integrated into the routine working procedures and services on the ward, it can be inferred that the locally prevailing circumstances do not entail any exclusion criteria.

The reprocessing requirements become more stringent depending on whether the beds are categorised as normal, risk or infectious beds, and the reprocessing steps can vary accordingly. The degree of hazard will depend, on the one hand, on the risks posed by infectious beds and, on the other hand, on the patient's susceptibility to infection [6]. The reprocessing requirements are least stringent for a normal or standard bed. Such beds are deemed non-critical items with only disinfectant cleaning being needed for the grip-contact surfaces of the bed frames.

The overall requirements governing a hospital bed are determined primarily by the needs dictated by hospital patient care and everyday routine tasks. In principle, hospital beds should comply with DIN EN 60601-2-38 [11]. As a precondition for manual or disinfectant cleaning of the mattress, a smooth covering (encasing) that lends itself to disinfection and is impermeable to liquids and microbes is recommended; this must cover at least the base and side surfaces. Coverings that en-

case the entire bed surface are better in terms of hygiene [12]. The bedlinen also plays a role in assuring bed hygiene since the patient and relatives tend to equate clean bedlinen with the general hygiene standard. Pursuant to the guideline of the Rober Koch Institute (RKI), clean bedlinen must be free of pathogens, have only a low microbial load or must be sterile in certain cases [6]. There is therefore a consensus that the bedlinen must be disinfected after each patient [4,8,12].

Decentralised bed reprocessing is carried out as a routine task by various occupational groups on the ward. The persons entrusted with this could be nurses, auxiliary nurses, cleaners or the employees of the bed collection and delivery services [13]. Bed reprocessing should be carried out when the bed is vacated by a patient or when urgently needed following visible contamination with blood, pus, faeces, urine or secretions [12]. The number of bed reprocessing operations conducted annually can be calculated from the following formula:

$$BA = \frac{(G \cdot B) \cdot 365d}{VWD}$$

BA = Bed reprocessing operations
G = Capacity utilisation rate
B = Beds provided
d = Days
VWD = Average hospital stay

Investment costs calculation

Since decentralised bed reprocessing requires neither special technical equipment nor dedicated premises and, furthermore, no specific requirements apply in terms of the bed design or of the fittings needed in the patient's immediate vicinity, it is difficult to put a figure on the investment costs, especially since it is assumed that the fittings used will in any case be available to assure normal ward activities. Therefore a 10% proportionate utilisation of fittings, such as ward trolleys and micro-processor-controlled dosage equipment is assumed here.

In simplified terms, for comparative cost calculation linear depreciation of capital investment is presupposed [14]. This gives an unchanging annual cost burden. Calculatory depreciation is worked out according to the following formula [14,15]:

$$KA = \frac{AK - RW}{ND}$$

KA = Calculatory depreciation p.a.
AK = Procurement costs
RW = Net book value (residual value)
ND = Service life

Calculatory interest is based on the following simplified formula [14,15]:

$$Z = \frac{AK - RW}{ND} \cdot zs$$

Z = Calculatory interest p.a.
AK = Procurement costs
RW = Net book value
ND = Service life
zs = Calculation interest rate

Construction costs

The storage space needed was realistically estimated to be 0.5 m² per care unit and the built-in hospital surface area, based on the hospital cost surface analysis, was set at an average of 1,500 EUR / m² [16]. Buildings are depreciated over a period of 33 years. Building costs vary in accordance with the number of wards and the number of bed reprocessing operations.

Personnel cost calculation

The biggest cost factor in the entire hospital cleaning and disinfection process, amounting to over 90 %, is the personnel cost factor [4]. Personnel costs were calculated based on personnel requirement calculation, while including the entire process of decentralised bed reprocessing in the calculation.

The chief determinants for evaluation of the entire process of decentralised bed reprocessing are the time invested in this task/bed, number of beds to be reprocessed / evaluation period and the remuneration scale for the occupational groups involved in bed reprocessing.

The data available on the time invested in decentralised bed reprocessing cover a broad spectrum, ranging from 1 to 25 min/bed unit, whereby a bed unit comprises the entire process of bed reprocessing including dismantling and cleaning adjacent surfaces such as the bedside locker, bed frame and patient trapeze bar. Based on the Nursing Personnel Regulation, which came into force in 1993, the average value in minutes for the entire process of decentralised bed reprocessing is estimated to be 10 min/bed unit [17]. This value is virtually identical to the internal

real-time data from an acute maximum-care hospital in Germany, which is based on an average time investment of 9 min/bed including dismantling time. This time value applies for the normal, risk or infectious bed since the reprocessing steps needed are almost identical in terms of time input. Therefore a time unit of 9 min was used as the calculation basis for the time invested.

Different models are used to calculate the number of beds to be reprocessed per day. Based on past experiences, the Bavarian Auditing Association (BKPV) [18] cites a value of 10-15 %, of the beds provided, for the number of beds to be reprocessed per day. Furthermore, the Bavarian Auditing Association calculates the ratio between the number of patients (without internal bed transfers) and the number of reprocessed beds to be generally between 1:1.2 and 1:4, but with downward and also (in exceptional cases) upward fluctuations seen. Another basis used to calculate the number of beds to be reprocessed per day is the Hamburg model, where the number of admitted patients is used as the basis. Hence for more exact results both the number of cases as well as the internal transfers, where the patient does in fact change to a different bed, should be used. Accordingly, this means that the number of cases per year (including the actual internal transfers) corresponds to the number of bed reprocessing activities.

The personnel costs based on full-time personnel requirement is calculated as per the following formula:

$$BA = \frac{(G \cdot B) \cdot 365d}{VWD}$$

VK = Full-time personnel per year
nA = Number of bed reprocessing operations p.a.
tA = Reprocessing time
tNJZ = Net annual working time

Since decentralised bed reprocessing is carried out by occupational groups belonging to the cleaning, collection and delivery services as well as nursing services, their deployment was calculated differently in the equation. As net annual working time, with the exception of the cleaning service (1,700 h/year), the time calculated for a full-time employee was based on 1,600 h/year. Personnel costs were calculated as per the German Federal Employees Wage Agreement Table East (Bundesangestelltentarif-Tabelle

Ost), remuneration for employees, as well as on customary practices, i.e. in the new German federal states a basic remuneration of 6.36 was calculated for the cleaning services as well as an employer contribution of 25 % of gross remuneration [19].

Material costs

For surface disinfection the consumption of disinfectant solution and the costs incurred for water and waste water, and in addition the consumption of fleece rolls when using the more modern dispenser system, were calculated. The costs for encasings were added as indirect costs.

2. Central bed reprocessing

Central bed reprocessing is carried out in a dedicated place which, for practical reasons, is mainly located in the hospital basement or at lower ground level [20]. It can be performed using either a manual or an automated method.

Regardless of the reprocessing method used, a clean and unclean side is needed for this bed reprocessing activity, with adequate space provided on each side for storing the beds, linen and other materials. The free space above automated disinfection equipment, in particular in the vicinity of the cabins, must not be reduced through installation of ventilation ducts, pipes, cable leads, etc. because unimpeded access to the electromotors, drive elements, valves and other operating components must be assured [21].

In principle, thermal disinfection based on a reprocessing system implies comparatively more exacting requirements in terms of the bed design than do decentralised reprocessing. The same can also be noted for manual bed reprocessing in a central bed reprocessing unit since alone bed transportation to and from, with in some cases having to place the beds in elevators and remove them again, has adverse effects on the guide roller materials.

Centralised-automated reprocessing of mattresses, covers and pillows is also carried out using steam disinfection equipment. Steam disinfection apparatus uses a vacuum-steam-vacuum (VSV) process pursuant to DIN 58949 [22]. Materials must tolerate without damage temperatures up to 105 °C for the VSV process [23].

Bed transportation is entrusted to persons belong to the nursing, collection, delivery or cleaning services.

Investment costs

The costs incurred for a reprocessing system are based on the data and the needs of the individual hospital as well as on the latter's ability to bargain. For the bed-washing facility provision should be made for investment costs of around 130,000 EUR [24]. Since the facility is used for mixed components, the costs for centralised-automated bed processing are calculated at 50 %. On that basis the costs per reprocessed bed unit or mattress are calculated while making a distinction between centralised-manual and centralised-automated reprocessing.

Construction costs' calculation

A useful area of around 155.25 m² is calculated for the central bed reprocessing unit based on the requirements to be met for operation of reprocessing systems and the storage space needed both on the clean and unclean sides.

Personnel costs

The personnel input needed for centralised bed reprocessing differs greatly from that required for decentralised bed reprocessing due to bed transportation from the ward to the central bed reprocessing unit, preparation of the bed for automated or manual reprocessing (pre-cleaning, dismantling), either manual reprocessing or loading the automated system, reassembly of the bed as well as bed transportation to the ward. As regards bed transportation, waiting times for elevators and long distances, determined by the location of central bed reprocessing unit, must also be included.

Conductance and organisation of centralised bed reprocessing is managed, depending on the individual institution, by the bed collection and delivery, cleaning and/or nursing services. The usual practice here is to have this task entrusted to different combinations of members of these services.

If one summarises the data in the literature on the time investment/bed [17,18,25], a personnel time input of 32–37 min, i.e. three- to fourfold greater reprocessing time compared with decentralised bed reprocessing, must be calculated for centralised bed reprocessing, including pre-cleaning per bed unit.

An average time investment of 16 min has been calculated for bed transportation to and from.

Based on real-time data, an average personnel time input of 27–29 min is needed per bed unit for centralised-manual bed reprocessing, including all transport services. Centralised-automated bed reprocessing takes an average of 23 to 25 min per bed unit. Taking into account realistic time values, the personnel requirement per centralised reprocessed bed unit is two- to threefold higher than decentralised-manual reprocessing.

Operating resources' calculation

The energy costs per bed are based on the size of the reprocessing system, useful cabin area and system-related consumption. Steam disinfection apparatus with different capacities is available for automated mattress reprocessing, if still carried out. Here the mattress core is exposed to steam disinfection. Hence a complete mattress cover would have no implications for material costs.

Maintenance costs and safety tests

The data available on the costs incurred for maintenance and safety tests differ from one service provider to the next. In terms of the servicing aspects, it is by all means possible to sign a maintenance contract with a manufacturer other than the manufacturer of the respective apparatus.

A figure of around 5,000 EUR annually is calculated for maintenance and repairs of a reprocessing system. It is difficult to apportion these costs to the reprocessed beds since the system is used for different purposes. Hence around 50 % the total annual costs of approximately 5,000 EUR can be realistically apportioned to bed reprocessing. This figure will depend on the terms agreed in the maintenance contract, the type of system, mixed utilisation and the utilisation capacity of the system in respect of bed reprocessing.

Material costs

The material costs comprise costs for detergents and disinfectants, cleaning and disinfection utensils as well as, in the case of manual reprocessing, for encasings. Here, too, it is true that the costs can vary greatly depending on the products used and on the purchaser's bargaining skills.

For manual bed reprocessing in the central bed reprocessing unit (centralised-manual bed reprocessing) similar material costs are incurred as for manual bed

reprocessing in the patient's room (decentralised bed reprocessing).

Calculation of costs incurred for bed transportation

The subsequent costs incurred for bed and container transportation are due to continuous painting and dry mortarless work, repair of doors and skirting boards, damage to outer areas and to the bed itself.

The damage resulting from bed transportation is estimated to amount to 10,000 EUR annually based on the fictitious example and its relationship with real-life data. Although this figure is based only on an assumption, the costs incurred for bed transportation must be viewed in a realistic light since in the case of decentralised bed reprocessing in the patient's room they are not incurred even on a proportional basis.

Results

For decentralised bed reprocessing the following actual costs were inferred on the basis of the studies outlined above:

Investment costs per reprocessed bed unit:	0,02 EUR
Construction costs per reprocessed bed unit:	0,02 EUR
Personnel costs per reprocessed bed unit in the nursing service:	3,45 EUR
Personnel costs per reprocessed bed unit in the collection and delivery service:	2,69 EUR
Personnel costs per reprocessed bed unit in the cleaning service:	1,35 EUR
Material costs per reprocessed bed unit:	up to 0,36 EUR

This gives a total investment per bed unit of up to 1.75 EUR when conducted by the cleaning service.

The cost allocation percentage is corroborated by the data in the literature indicating that personnel costs account for the highest item of expenditure. This continues to be true regardless of which occupational group or combination of personnel groups conducts this task.

While the material costs are shown as being the second major cost item, accounting for 21 % of the total costs incurred for a reprocessed bed, the differential versus the 77 % calculated for personnel costs must be borne in mind in

further appraisals. The construction and investment costs per reprocessed bed unit accounting, in each case, for 1 % of the total costs per bed represent the lowest proportion of total costs per bed.

The following, rounded-off, actual costs were calculated on the basis of research data for centralised-manual bed reprocessing:

Investment costs per reprocessed bed unit:	0,01 EUR
Construction costs per reprocessed bed unit:	0,14 EUR
Bed transportation costs per reprocessed bed unit:	0,21 EUR
Personnel costs per reprocessed bed unit only by the cleaning service:	4,34 EUR
Material costs per reprocessed bed unit:	up to 0,36 EUR

When carried out by the cleaning service this corresponds to a total expenditure per centralised and manually reprocessed bed unit of around 5.06 EUR.

The cost allocation percentage is corroborated by the data in the literature indicating that personnel costs account for the highest item of expenditure. This continues to be true regardless of which occupational group or combination of personnel groups conducts this task.

The personnel costs incurred by the cleaning service amounted to 86 %. The material costs accounted for 7 % of the total costs per reprocessed bed unit.

The major time investment for bed transportation is a conspicuous finding when analysing the costs incurred for centralised-manual bed processing, with just below two-thirds of this time being spent exclusively for transporting the beds to and fro. In terms of economic efficiency, it is advisable to assign bed transportation duties to those staff members with the lowest personnel costs.

In certain partial processes the costs for centralised-automated bed reprocessing must be analysed separately because of deviations vis-à-vis centralised-manual reprocessing.

The following costs/bed are relevant for centralised-automated bed processing:

Investment costs per bed unit:	0,41 EUR
Construction costs per bed unit:	0,14 EUR
Personnel costs per bed unit:	
a) only cleaning service:	3,74 EUR
b) combination of staff members from collection, delivery and cleaning services:	6,13 EUR
Material costs per bed unit:	0,02 EUR
Bed transportation costs per bed unit:	0,21 EUR
Maintenance / repair costs per bed:	0,05 EUR
Operating resources' costs per bed:	3,37 EUR

Overall, the minimum costs incurred with deployment of cleaning personnel per centralised automated reprocessed bed unit are around 7.94 EUR. Already a combination of staff members from the collection, delivery and cleaning services gives rise to a total cost per bed unit of approximately 10.33 EUR.

On apportioning the above costs incurred for a centralised-automated reprocessed bed, the personnel costs account for the greatest proportion of the total costs. When carried out by the cleaning service, the investment costs, bed transportation costs, construction maintenance and repair as well as material costs amounting altogether to 11 % of the total costs do not offer much scope for assuring more economical reprocessing.

The cost allocation profile per bed for a centralised-automated reprocessed bed changes if this is entrusted to a combination of staff members from the collection, delivery and cleaning services instead of to the cleaning service. In such cases, personnel costs account for around two-thirds of the entire costs. Accounting for one-third of costs, the operating resources' costs are a salient feature. Investment costs, bed transportation costs, construction, maintenance and repair as well as material costs amounting together to 7 % of the total costs tend to be of more or less negligible.

As regards the personnel costs, which are the main cost item, analysis of personnel input for the various process steps of centralised-automated bed reprocessing shows that the bed transportation partial process accounts for around two-thirds of these.

Overall, personnel costs, even in cases of deployment of the occupational group with the lowest costs, account for the

highest proportion of the total costs both for centralised-manual and centralised-automated reprocessing. The operating resources' costs account for 42 % of the total costs when carried out by the cleaning service. Conversely, and refuting the theory whereby the investment and construction costs, after the personnel costs, account for the greatest proportion of costs, here the operating resources' costs constituted the second biggest proportion of the total costs incurred for centralised-automated bed reprocessing

Discussion

In principle, it can be stated that the effectiveness of all three processes studied is confirmed. For example, for manual surface disinfection certified surface disinfectants endowed with an efficacy level similar to that of a bed disinfection chamber are used, and proof of the germ impermeability of the encasings has been furnished [26].

Decentralised bed reprocessing is the most cost-effective method while producing similar reprocessing results. The costs for centralised-manual or centralised-automated reprocessing are 2.9 and 4.5 times, respectively, higher compared with decentralised bed reprocessing. Even a comparison of centralised-manual with centralised-automated reprocessing shows a difference of around 1.6-fold.

Both in economic and hygiene terms, decentralised bed reprocessing represents the reprocessing method with the best means-end relationship. Hence, in respect of (economic) efficiency centralised-manual and centralised-automated bed reprocessing can no longer be recommended. Since hospital beds are governed by the Medical Devices Act, a standard operating procedure (SOP) must be compiled for decentralised bed reprocessing. This SOP must specify how bed reprocessing is to be organised and conducted, while also giving information on how to manage different risk categories and making a distinction between discharge beds and beds that must be reprocessed during the patient's hospital stay.

Subject to the premise that comparable hygiene reprocessing results are assured, decentralised bed reprocessing offers least scope for cost cutting, followed

by centralised-manual bed reprocessing, while centralised-automated bed reprocessing offers the greatest potential for cost reduction.

Since personnel costs account for the highest percentage of the total costs, preference should be given to deployment of the occupational group with the lowest costs, i.e. this task should be entrusted to the cleaning service. However, this does not suggest that only the cleaning service should be responsible for the reprocessing methods studied. Rather, bed reprocessing duties should be assigned mainly to the cleaning service, in particular during peak times arising when there is a high number of beds being vacated because of patient admissions or discharges. The personnel costs can be influenced not only on the basis of collective wage agreements by the type of service (occupational group) selected, but also by the hospital's internal workflow patterns and structural organisation with the aim of cutting costs.

If the hospital has a central bed reprocessing unit for manual or automated bed reprocessing, for cost-efficiency reasons this must be operated by members of the cleaning service. The same holds true for bed transportation. Only if there is reason to increase the capacity utilisation rate of a more cost-intensive service type, i.e. the collection, delivery or nursing services, should such staff members be entrusted with bed reprocessing or, possibly, bed transportation tasks.

After personnel costs, the sum of the material and operating resources' costs represents the greatest percentage of costs incurred for centralised-automated bed reprocessing. Therefore for business management reasons preference should be given to manual bed reprocessing in a central bed reprocessing unit rather than to automated reprocessing. The much-discussed investment costs for bed reprocessing equipment / systems are in fact exaggerated.

The establishment of hospital purchasing associations (e.g. for disinfectants) and user associations (e.g. for energy) could be contemplated as a means of reducing the material and operating resources' costs [27], so as to be able to negotiate discounts based on the high consumption levels and to reduce the supplier's risk on the basis of the number of combined buyers and users. Likewise, the operating resources' costs could be re-

duced by bargaining, award of discounts and appropriate controlling.

In addition to these possibilities, savings can be made every time unnecessary costs are avoided. For example, one aspect of centralised bed reprocessing that drew attention was precleaning of the guide rollers with high-pressure cleaning equipment as these had become contaminated while transporting the bed to the central bed reprocessing unit. It is thus here that there is scope for cost cutting. This situation is further compounded by the fact that the guide rollers will be contaminated once again when returning the bed to its original site and must be cleaned again to avoid contamination of the ward. These type of processes that waste resources and are not fit for purpose should be discontinued for hygiene as well as economic reasons.

Bringing technical hygiene into line with the patients' changing demands in the hospital setting is a continuous process. There are also factors, of possibly less significance, that support decentralised bed reprocessing in the patient's room, such as confronting patients and visitors in the hospital with scenes of beds being transported to and from, or beds stored in hospital corridors as well as the excessive demands made on the goods' elevator capacity by bed transportation.

In this respect, ongoing discussion is needed about whether, bearing in mind economic and medical aspects, there is any need at all to move a patient's bed within the hospital. The immobile hospital bed would mean that such beds could be bought while investing fewer resources since, in particular, the cost-intensive guide rollers could be dispensed with. However, this presupposes the implementation of hygienically impeccable decentralised reprocessing of these immobile beds. Stretchers could be used to transport patients within the hospital. Such stretchers are being used already for transportation purposes in intensive-care medical rescue operations and are characterised by their ease of handling and high degree of compatibility [28, 29].

Conflict of Interest

The authors declare that there is no conflict of interest as understood by the International Committee of Medical Journal Editors.

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