KwaZulu-Natal Epidemiology Bulletin

Issue 7

June 2004

Use of the indicators to assess hospital efficiency

Published Quarterly by:
The Epidemiology Unit
KwaZulu-Natal Department of Health
Private Bag X9051
Pietermaritzburg 3200

This issue has been sponsored by the Italian Cooperation

EDITORIAL

The word hospital conjures up the picture of a physical structure containing highly skilled professional staff, specialized equipment and the notion of improved health status. The perpetuation of this concept has resulted in many health systems having a strong hospital focus with a high per capita health expenditure yet limited improvement in health status indicators.

South Africa recognized the strong emphasis on curative hospital care that existed prior to 1994. The adoption of the District Health System policy to address this imbalance has re-focused resources to the organisation and delivery of primary health care services. This has resulted in greater equity in healthcare funding and improved population access to health care services. However, the attention given to primary health care has diverted attention away from hospitals.

The synergy between a functional primary health care service, coherent referral pattern and efficient hospital services cannot be denied. A health sector reform agenda that considers only one-area runs the risk of not fully exploiting the opportunity to improve performance across all three areas.

This issue of the Epidemiological Bulletin focuses on the area of hospital efficiency in the context of hospital typology. It provides managers at all levels useful insight on how hospital efficiency can be measured using hospital indicators within a standardised assessment methodology. This begs the question regarding the validity and quality of data being collected. Data inconsistencies may render any methodology unreliable. Hospital management teams must take ownership of the data generated at facility level. Descriptive analysis should be used at the local level to ensure data inaccuracies are kept to a minimum and variations in trends can be timeously explained.

The hospital sector in KwaZulu Natal is undergoing transition. This must be monitored to ensure that efficiency targets are met. Further, it allows policy makers to identify areas of inefficiencies that absorb health resources to the detriment of other health programmes.

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ACRONYMS & DEFINITION OF TERMS

ALOS	The Average Length of Stay is the number of days spent in hospital by the average patient. In this issue it is obtained by dividing the number of days spent by the inpatients (inpatient days) by the number of inpatients (discharges + deaths).
Case mix	This term is used to describe the complexity of the inpatients. Hospitals having a higher proportion of complex cases (i.e. Regional hospitals) need to be assessed separately from hospitals admitting less complex cases (i.e. District hospitals).
Cost per day	The cost per day is the cost per equivalent patient day. This is calculated by the DOH as = (expenditures)/(inpatient days + transfer in + 1/2 day patient + 1/3 outpatient headcount). It would have been better to use the cost per inpatient day, which is obtained by dividing the expenditures of the inpatient services by the number of inpatient days. Because this was not available, the cost per equivalent patient day was used as the best available proxy of economic efficiency.
Cost per discharge	This indicator of economic efficiency is similar to the cost per inpatient day, with the difference that the expenditures to run the wards are divided by the number of discharges. Although the cost per discharge was not available, it has been described to provide an overview of the indicators.
DOH	Department of Health.
DRG	The Disease Related Group is used in some countries to reimburse hospitals with a fixed amount per patient discharged. The amount depends on the discharge diagnosis.
Efficiency	In this issue, efficiency is used to indicate the optimal utilization of resources in terms of high occupancy and high turnover.
HIS	Health Information System.
Inpatients	The proxy for inpatients used by the DOH is the sum of "discharges + deaths".
FIO	Facility Information Officer.
FY	Financial Year.
KZN	KwaZulu-Natal.

Mortality In this issue, mortality has been estimated by dividing the number of deaths by the "discharges + deaths". This is based on the fact that the sum of "discharges + deaths" has been used as proxy for inpatients in the other indicators.

Occupancy The proportion of occupied beds is measured in this issue by dividing the number of inpatient days by the number of bed days (beds * days in a year).

PIC Provincial Information Coordinator.

Reliable A measurement is reliable if it provides the same value when it is repeated under identical conditions. For example, if the number of beds in a hospital does not change across years a reliable reporting will provide always the same number while an unreliable one will report different numbers. If there are no real changes and the reported number of beds is unreliable, the occupancy and turnover will have false fluctuations because the numbers of beds will affect the denominator of these indicators. Reliability is not to be confounded with validity, which is the ability to report real values. For example, a hospital that has always had 300 beds across the years, may have reliably reported all the time the same invalid lower value of 250 beds.

Turnover In this issue, the monthly turnover has been estimated by dividing the average monthly number of inpatients (discharges + deaths) by the average monthly number of usable beds.

Validity A valid measurement reflects the real value. For example, if there are 300 beds in a hospital, a valid reporting will be 300 and validity will decrease with increasing difference from the real values.

AKNOWLEDGEMENT

This issue of the Epidemiology Bulletin is a joint product of the KwaZulu-Natal Department of Health (DOH) and the Italian Cooperation, which provided the technical support and paid for the printing costs. The analysis would not have been possible without the Annual Report on the Health Statistical Information compiled by the Informatics Directorate of the DOH. Dr. Venanzio Vella, Epidemiologist of the Italian Cooperation, provided the technical support for the analysis and the write up. This issue was finalized by the members of the Epidemiology Bulletin Committee, which is coordinated by Dr. Thilo Govender, Principal Epidemiologist of the DOH.

ABSTRACT

This issue is based on an analysis of the hospital statistics published by the KZN DOH. The hospital statistics is collected to provide the DOH with indicators of hospital efficiency to improve the use of resources. The last publication[1] from the Informatics Directorate consists of many tables but it does not provide any interpretation, leaving up to the managers the task of elaborating the information. This issue provides guidance on how to check for the consistency of the hospital indicators and how to interpret them to identify hospitals with different degree of efficiency.

The introduction describes the use of the hospital indicators. Occupancy and turnover are the most common measures of hospital efficiency, which is the optimal utilization of resources to transform inputs into outputs. This means, full utilization of beds and high turnover to produce more discharges. Efficiency is not to be confused with overall performance that includes quality and standard of care.

Several techniques have been applied in this issue of the Epidemiology Bulletin to measure hospital efficiency. After a consistency check of the data, the indicators have been interpreted to build several efficiency profiles by plotting the hospital indicators on the Pabon Lasso graph.

Central and Regional hospitals have been analysed separately from the District hospitals. Among the Regional hospitals, efficiency in terms of occupancy and turnover was highest for Gandhi and lowest for King George. Among the District hospitals, the highest efficiency was for Vryheid and Northdale while Montebello and Mbongolwane had the lowest efficiency. Several hypotheses have been formulated to explain the reasons for these findings, but it will be up to the managers to find the causes behind low utilization and to suggest solutions whose effectiveness needs to be measured by monitoring the change in the indicators across years.

[1] Health Statistical Information. Informatics Directorate. DOH. 2004

Introduction

Efficiency is the ability to optimize the use of resources to produce outputs. Hospitals receive a certain budget according to their category, size, type of patients and other criteria. The budget is used to maintain the infrastructure, the equipment, the salaries and other inputs. The efficient use of these inputs can be measured in terms of bed occupancy, average length of stay, average turnover and other indicators. The outputs can be measured in terms of inpatient days and discharges. To have an economic measure of efficiency, the expenditures are divided by the outputs to estimate the cost per unit of output such as the average cost per inpatient day or per discharge.

Figures 1 and 2 show the relationship between the hospital indicators and the use of resources, taking into account the type of patients. Figure 1 shows the hypothetical situation in which two hospitals with the same typology of patients spend 800,000 rands per month to run the daily activities related to their inpatients' services. Hospital A is inefficient because it has a lower occupancy and a lower turnover than hospital B. This lower efficiency in the utilization of inputs by hospital A translates into a lower production of outputs in terms of discharges compared to hospital B. For this reason, the cost per discharge derived by dividing the total costs by the number of discharges is higher for hospital A compared to hospital B. Because the two hospitals have similar inputs and similar patients, it is possible to compare them in terms of efficiency.

Figure 1 Efficiency in comparable hospitals

Comparable Hospitals		
	Same Resources i.e. 800,000 Rands per month **Same inputs** Similar number of beds, equipment, staff, etc **Same type of patients** i.e. patients with similar medical conditions	
	Hospital A	**Hospital B**
Efficiency in utilizing the same resources and inputs	Low	High
Bed occupancy	35 % bed occupied	70% bed occupied
Turnover	2 patients per bed per month	7 patients per bed per month
Average length of stay	4.5 days	3 days
# discharges	133 discharges per month	400 discharges per month
Cost per unit of output (i.e. per discharge)	6000 R (800000 Rands divided by discharges)	2000 R (800000 Rands divided by discharges)

Figure 2 depicts the lack of comparability of indicators between hospitals having different types of patients. Hospital C receives less complicated patients and requires a lower budget, because of its less specialized staff and less costly equipment compared to hospital D. Because hospital C admits less severe patients, their faster recovery is associated with shorter stay and higher turnover compared with patients of hospital D. This is associated with a higher number of discharges leading to a lower

cost per discharge in hospital C compared with hospital D. However, it would be wrong to conclude that hospital C is more efficient than hospital D. Because the two hospitals care for different medical conditions, hospital C has to be compared only with its own category of hospitals and not with Hospital D.

Figure 2 Lack of comparability between two different hospitals

	Hospital C (District hospital)	**These two hospitals are NOT comparable**	**Hospital D (Regional hospital)**
	800,000 Rands per month	**Different Resources**	1.4 million Rands per months
	57 beds, district hospital staff, etc	**Different inputs**	620 beds, more specialized staff, etc
	Less complicated patients	**Different patients NOT Comparable. The production needs to be compared with the same category of hospital**	More complicated patients
Efficiency			
Bed occupancy	69%		65%
Turnover	7 patients per bed per month		3 patients per bed per month
Average length of stay	3 days		6 days
# discharges	400 discharges per month		2000 discharges per month
Cost per discharge	2000 Rands (800,000 divided by the discharges)		7000 Rands (1.4 million divided by the discharges)

Hospital indicators are required to justify the use of scarce resources. Hospitals consume a substantial amount of the DOH budget because of their substantial cost related to the high concentration of expensive equipment and staff. Inefficiency is cause for concern because it is associated with underutilized hospitals and therefore poor use of limited resources. Indicators of hospital utilization help to describe if the resources spent are worth the costs per unit of output.

This is especially relevant today because of the changing priorities of the health sector and the higher importance given to Primary Health Care compared with the past. It is in this context that each hospital manager has to use the hospital indicators to account for the use of resources assigned to his/her own hospital. Low utilization is hardly justifiable because the limited resources could be reassigned to alternative forms of care. Accountability is required because (a) financing is associated with denying the same resources to other services (opportunity costs), and (b) scarce resources need to be assigned to services having the highest potential to produce benefits. With limited resources and multiple priorities, budgetary decisions need to be made on the share of available resources that should be assigned to hospitals compared to other services.

Indicators

As mentioned in the introduction, the efficient use of inputs is measured through indicators of utilization. The raw data on beds and other inputs are transformed into occupancy, turnover and average length of stay. Occupancy is the proportion of beds

that are occupied, turnover is the average number of patients per bed in a certain period of time (i.e. monthly), and the average length of stay (ALOS) is the average number of days spent in hospital.

Occupancy and turnover need to be considered together before deciding if a hospital is fully utilized. High occupancy is not associated with full efficiency if patients have a low turnover and therefore stay longer than necessary. As mentioned in Figure 1, the efficient utilization of inputs is associated with the production of more outputs such as inpatient days and discharges. If all beds are occupied but there is a low turnover, patients may well occupy all the beds and therefore produce a high number of inpatient days but the number of patients discharged may be relatively low. If all the beds are occupied and there is also a high turnover, both inpatient days and discharges are high.

Dividing the costs by the number of outputs provides a measure of economic efficiency. The average cost per inpatient day or per discharge can be obtained by dividing the expenditures sustained to run the wards by the number of inpatient days or by the number of discharges produced. Therefore, a hospital with high occupancy and low turnover will have low cost per inpatient day but a high cost per discharge because its costs are divided by its high number of inpatient days and by its relatively low number of discharges. The highest efficiency is associated with high occupancy and high turnover, which produces high numbers of inpatient days and discharges, resulting in both low cost per day and low cost per discharge.

Interpretation of efficiency

The hospital indicators must be judged with a high degree of caution before jumping to conclusions about efficiency. The first step is to analyse hospital efficiency by hospital category to control for patient mix. Because hospitals in the same category are supposed to cater for patients affected by relatively similar medical conditions; differences in occupancy and turnover within the same category of hospitals should be related to efficiency. Therefore, comparing the occupancy and turnover of a hospital with the average for its own category helps to understand if the hospital is properly utilized.

However, even within the same category there is a certain degree of variation. A regional hospital may have a higher proportion of complex cases or a higher rate of surgery compared with the average for its own category. It follows that, although a hospital with lower than average occupancy and turnover for its own category is likely to use resources inefficiently, other reasons should not be excluded. For example, although in the statistical information used in this analysis King George was categorized as a Regional hospital it had more the characteristics of a specialized hospital. Its very low utilization might therefore have been related to the very complex typology of patients causing low occupancy because of fewer patients demanding such very specialized care. The lengthy recovery required by these patients may also have caused low turnover. Therefore, a hospital may be considered inefficiently utilized because it is compared with the average for its own category, which may not always reflect the types of patients admitted in this hospital. In this context, such analysis may be helpful to assess if a certain hospital is correctly categorised or if it should be reassigned to another category.

Another reason why occupancy and turnover should be used carefully is related to the influence that financing has on these indicators. In countries where hospitals are reimbursed according to inpatient days, the incentive is to keep patients longer than required. In countries using the Disease Related Groups (DRG), which is the reimbursement of a fix amount per type of discharge, the incentive is to discharge patients as soon as possible. If this is the case, the DRG can create perverse incentives because hospitals may discharge patients before full recovery. An excessive shortening of the length of stay may not be an efficient use of resource if it is associated with a high rate of complication after discharge and subsequent high rates of readmission of the same patients. Another perverse incentive associated with the DRG is the tendency to admit only remunerative patients with exclusion of certain medical conditions. These factors should be taken into account by the DOH in case policy changes in hospital financing are considered.

Efficiency versus standards of care

Although there is some relationship between efficiency and performance, these terms are not synonyms. The previous paragraphs mentioned that hospitals may be efficient in terms of high occupancy and turnover, but this can cause lower quality of services, higher degree of complications after discharge and exclusion of certain patients. There is a need to differentiate between efficiency in terms of resource utilization, and performance in terms of standards and quality of care. Using resources efficiently in terms of full occupancy does not necessarily equate to high standard of care and vice versa. High occupancy is not necessarily a positive aspect if it is associated with overcrowding, decrease in quality of service and staff overburdening. Low occupancy may be associated with inefficiency, such as in the case of a highly specialized hospital not working at full capacity, but its low occupancy may be associated with high standards of care. Therefore, indicators of efficiency suggest which hospitals are utilized more or less at full capacity so that planners can reassign resources accordingly; but this does not provide any indication about the hospital performance in terms of standards of care.

Use of the indicators

The hospital indicators are used to achieve policy, planning and management objectives. Resources will never be sufficient to match all the health needs and policy makers have to decide what will be the best use of available resources. Planners need to set up implementation strategies and managers need to monitor their implementation. For example, policy makers identify strategies to serve more people through less expensive alternative services; planners put the strategies in place by quantifying the inputs and the costs, and by setting up implementation mechanisms; and managers monitor implementation and apply corrective actions as problems arise.

The hospital indicators help to improve the achievement of the above policy, planning and management objectives. The information can be used to decide if the present use of resources is justified, if reassignment would provide better value for money and if the implementation of reassignment of resources improves efficiency. For example, the increasing toll that AIDS and chronic degenerative diseases have on the hospitals require alternative services for long-term care such as nursing homes or

home based care. The efficacy of introducing such alternatives can be measured through a change in hospital occupancy and turnover, average length of stay, cost per discharge in those hospitals that were previously admitting a high proportion of long-term patients. Monitoring the above process through the changes in the hospital indicators serves the purpose of making policy makers, planners and managers accountable for their respective areas of responsibility.

Focus of this issue

This issue focuses on the interpretation of the hospital indicators in terms of utilization of resources. The methodology describes the consistency check and the interpretation of the hospital indicators in terms of efficiency. The results describe the application of these techniques to the data coming from the Central, Regional and District hospitals. The discussion provides concluding remarks about the use of these techniques to achieve better management.

Methodology

Data source

The data used in this analysis are from the latest Health Statistics Information[2], which is the annual publication of the indicators derived from the Health Information System (HIS). The hospital data was related to the period FY00/01 through FY02/03. Before carrying out any interpretation on the hospital indicators, a quality check was done on the data because the reliability of the indicators depends on the reliability of the data reported on the numbers of beds, discharges, inpatient days and deaths. Therefore, it was necessary to check the consistency of these numbers by comparing the trends in these variables across years. The technical details are in the Annexes.

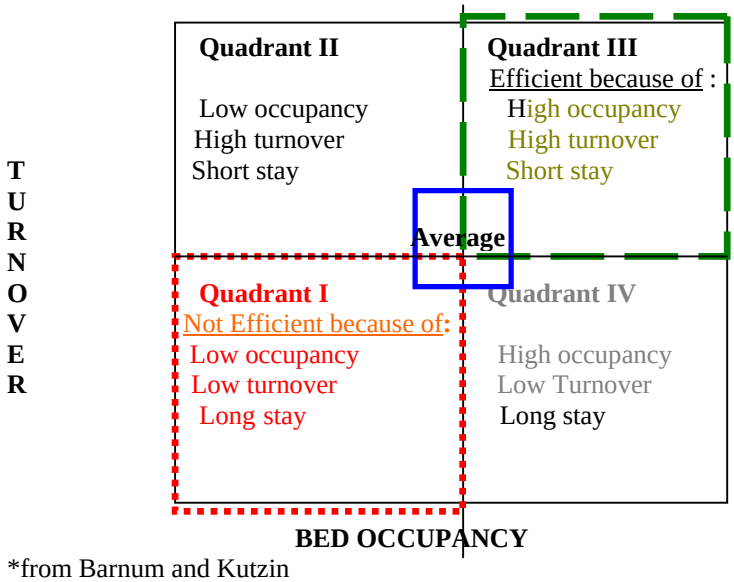
The only available economic indicator was the cost per equivalent patient day, which is derived by dividing the expenditures by the equivalent patient days[3]. The cost per inpatient day or per discharge would have been more specific to evaluate the economic efficiency of inpatient services. These indicators, which are obtained by dividing the expenditures to run the wards by the number of inpatients days and by the discharges, are more relevant to the inpatients' costs while the cost per equivalent patient day is less specific. Nonetheless, the cost per equivalent patient day is a good proxy of cost per inpatient day because most of the expenditures of a hospital are consumed by inpatient services and most of the equivalent patient days are contributed by the inpatient days.

[2] Health Statistical Information. Compiled by Informatics Directorate. DOH 2004.
[3] inpatient days+transfers in+1/2 day patients + 1/3 outpatient headcount

Interpreting efficiency

After the data cleaning, the hospitals were plotted on the Pabon Lasso graph to interpret efficiency[4]. A technique, which is common practice among hospital managers around the world, was introduced in 1986 by Pabon Lasso[5] to plot the hospitals in the four quadrants of Figure 3. These quadrants are formed by the intersection of the average bed occupancy and the average bed turn over for the same category of hospitals such as the District hospitals. Quadrant I, surrounded by dotted lines, is characterized by low occupancy and low turnover and therefore under-utilization. This may be related to a higher number of beds than needed and/or a low demand for hospitalisation. Quadrant II is characterized by a higher than average turnover and a lower than average occupancy. This may be related to a higher number of beds than needed and/or unnecessary hospitalisations, and/or a high number of normal deliveries. Quadrant III, surrounded by broken lines, is characterized by an efficient utilization of resources because the occupancy and turnover are higher than the average. Quadrant IV is characterized by a higher than average bed occupancy and a lower than average turnover. A high proportion of severe patients and or a high proportion of long term cases, and or unnecessary long stay may cause this situation. The area near the centre, surrounded by a box, is where average hospitals are located.

Figure 3 Interpretation of efficiency according to Pabon Lasso*



*from Barnum and Kutzin

[4] This section is based on Barnum H and Kutzin J (1993).

[5] Pabon Lasso, Hipolito. Evaluating Hospital Performance through Simultaneous Application of Several Indicators. Bulletin of the Pan American Health Organization 20 (4): 341-57; 1986.

Plotting the hospitals according to occupancy and turnover makes sense only if the hospitals have similar characteristics. Tertiary hospitals are likely to accept more complicated cases than District hospitals and therefore they should be considered separately. Once the hospitals with the same characteristics are plotted on the Pabon Lasso graph, it is possible to group them in the four quadrants and to rank them according to average, lower or higher than average utilization. As explained in the introduction, efficient utilization should be interpreted with caution. Measuring the above and below average efficiency is not always ideal if there is a high degree of variation within the same category of hospitals. Another point to be taken into account is that efficient utilization does not equate to performance in terms of standard and quality of care.

An important point to be taken into account is the role of the central level versus the periphery. It would be wrong to assume that the central level should just compile an annual report filled with table and abdicate its responsibility under the assumption that the managers knows best what is going on in their hospitals. The central level has the responsibility to analyse the data to build efficiency profiles, generate hypotheses on the variation in efficiency and identify solutions. The managers can than help to verify these hypotheses by implementing the suggested actions to improve hospital efficiency.

Results

The results are presented by hospital category, with Central and Regional hospitals considered together, followed by the District hospitals. For each hospital category, the results are divided into consistency check and interpretation of the indicators in terms of efficiency. It has to be kept in mind that the results presented here are based on the data published in the latest publication of the DOH. Some of these data are likely to change as a result of the validation that will be conducted in the future.

Regional hospitals

Indicators' consistency

As described in the Annexes, the data were checked for consistency. Before accepting as real, any change in occupancy and turnover reported across years, it was necessary to check the consistency of the trends in the data reported on beds, inpatient days, discharge and deaths. The raw data form the numerators and the denominators of the indicators and if these numbers are unreliable, the change in the indicators may be related to unreliable reporting of the raw data. Therefore, the first step was an assessment of the raw data between FY00/01 and FY02/03. As explained in the Annexes, because there were several problems of comparability between FY00/01-FY01/02 and FY02/03, only FY01/02 was taken into consideration for the interpretation of efficiency.

Efficiency

After the quality check on the raw data, the indicators were re-estimated and plotted on the Pabon Lasso graph. Figure 4 shows the location of the hospitals in the four

quadrants of Pabon Lasso for FY01/02. The four quadrants reproduce the different areas of efficiency described in the introduction. King George and Madadeni were the least utilized; Prince Mshiyeni, King Edward and Edendale had average occupancy but low turnover; Stanger, Newcastle, Port Shepstone and Ladysmith had average occupancy and turnover; Grey and Ngwelezana had high occupancy but low turnover; Khan and Addington had high occupancy and high turnover; and Lower Umfolozi and Gandhi were the most utilized.

The cost per day had a less clear pattern than expected. As it was mentioned in the introduction, the increasing utilization leads to lower cost per day because the costs are divided by a higher number of days. Figure 5 shows that this is true for Gandhi, which had high efficiency and low cost per day, but there were several exceptions. For example, Lower Umfolozi had high utilization but high costs per day while King George had low utilization and low cost per day. Further evaluation of the quality of the data on the cost per equivalent patient day is needed to exclude that these findings are related to poor reliability of the data.

Higher occupancy was associated with higher mortality. Figure 6 shows that hospitals located towards the right hand side of the Pabon Lasso graph had higher occupancy and higher mortality, compared with the hospitals located on the left hand side of the graph. This may be related to a higher severity of patients being admitted in the most utilized hospitals. However, this hypothesis needs further investigation because within the same level of occupancy and turnover there is a certain variation, with Khan and Addington having high occupancy and low mortality. This may be due to the variation in the typology of patients that is present even within the same category of hospitals or to problems in data reporting.

Table 1 Indicators for Regional and Central hospitals in FY01/02

TYPE	DISTRICT	Hospital	Occupancy	Turnover	Mort rates	Cost per day
Regional	Amajuba	Madadeni	44	3	6	527
		Newcastle	58	5	4	843
	eThekwini	Addington	76	5	6	862
		King George	41	1	6	554
		M Gandhi	122	7	11	413
		Prince Mshiyeni	70	3	7	579
		RK Khan	77	5	4	557
	iLembe	Stanger	69	5	7	454
	Ugu	Port Shepstone	72	4	7	571
	uMgungundlovu	Edendale	63	3	8	867
	Uthukela	Ladysmith	59	4	7	580
	Uthungulu	Ngwelezana	97	4	12	926
		Lower Umfolozi	76	7	1	1155
Average			**69**	**4**	**7**	**651**
Central*	eThekwni	King Edward	69	2	6	921
	uMgungundlovu	Grey's	83	4	5	946
Average			**75**	**3**	**6**	**1018**

*Wentworth was excluded for FY01/02

Figures 4 Regional and Central hospitals, efficiency in FY01/02

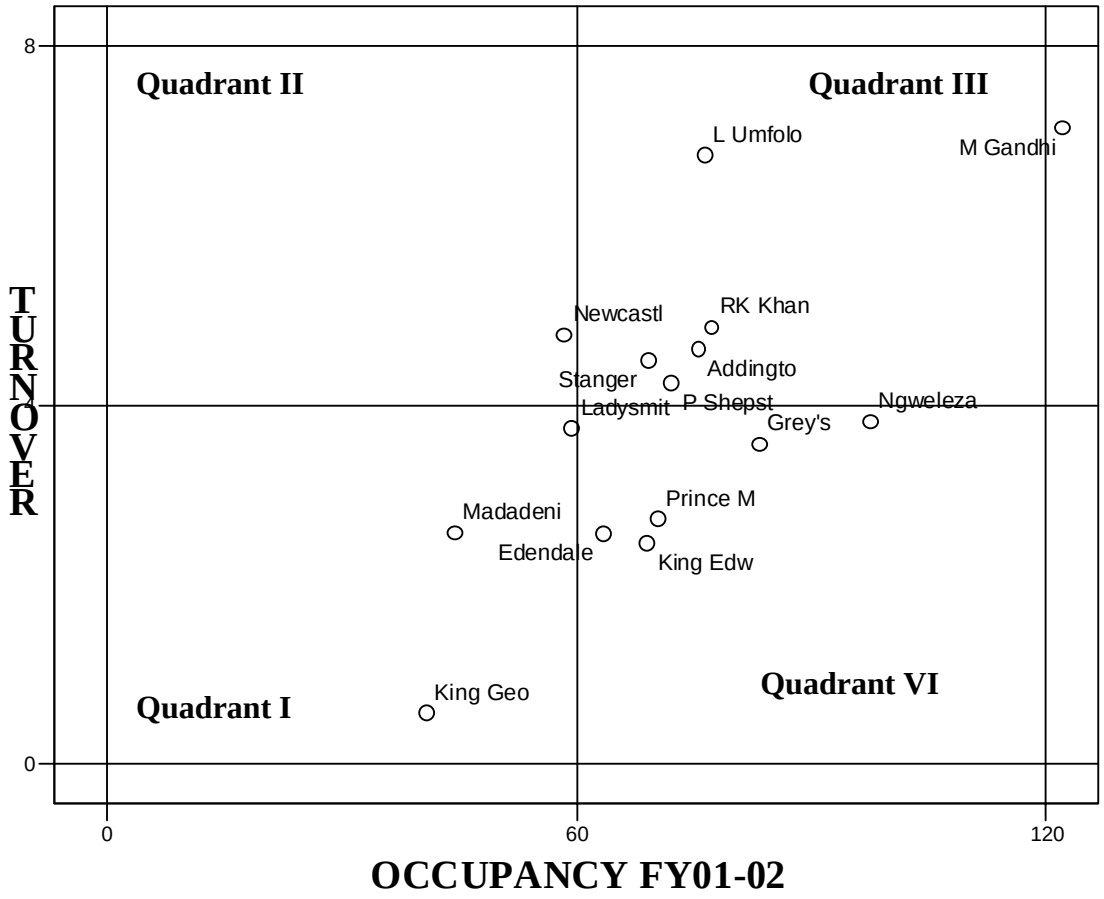
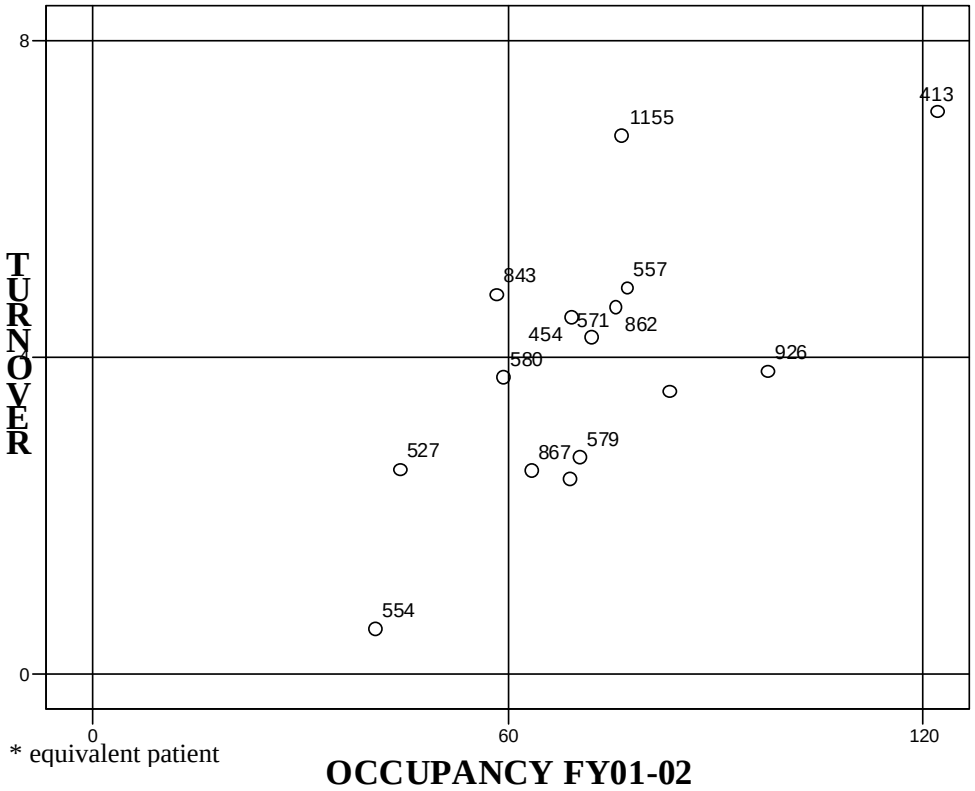
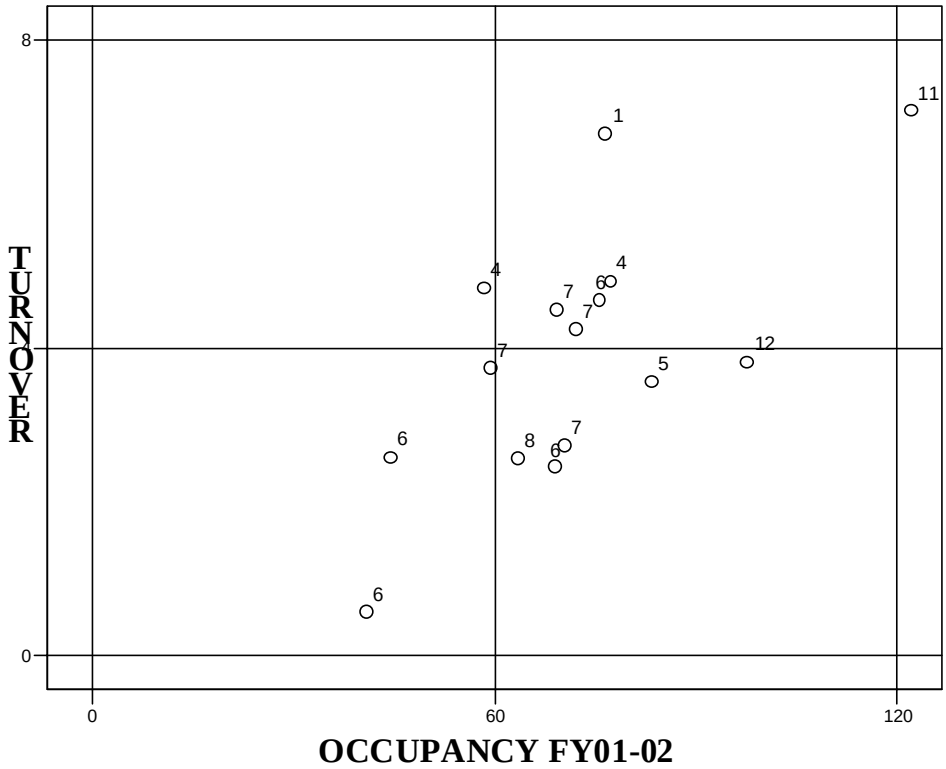


Figure 5 Regional and Central hospitals, cost per day* FY01/02



* equivalent patient

Figure 6 Regional and Central hospitals, proportional mortality in FY01/02



District hospitals

Indicators' consistency

A quality check identified several problems in the data reported by the District hospitals. Some hospitals had inconsistent indicators because of misreporting of the numbers of beds, inpatient days, discharges and deaths. As for the Central and Regional hospitals, several District hospitals had unreliable data affecting the interpretation of changes in the indicators. Because of potential comparability problems, only FY01/02 was taken into account. The technical problems found in the raw data are described in the Annexes.

Efficiency

The results are presented in the same manner used for the Central and Regional hospitals. Figure 7 shows the location of the District hospitals in the Pabon Lasso graph, with hospitals in quadrant I having low utilization, quadrant II being characterized by low occupancy but high turnover, quadrant III containing highly utilized hospitals and quadrant IV having hospitals with high occupancy but low turnover.

As expected, the cost per day declined with increasing utilization. Figure 8 shows that on average, the hospitals on the right hand side quadrants had a higher occupancy and a lower cost per day compared with those ones on the left hand side quadrants. This confirms that when expenditures are spread over a higher number of outputs, such as a higher number of equivalent patient days, the cost per output declines.

Figure 9 shows the hospital mortality in District hospitals in FY01/02. As with Central and Regional hospitals, increasing occupancy is associated with increasing mortality, suggesting that fully utilized hospitals may have more severe patients. However, the hospitals located towards the left part of the graph are divided into two groups characterized by similar lower occupancy but different levels of turnover and mortality. The upper right quadrant is characterized by lower occupancy, higher turnover and lower mortality, suggesting the presence of less severe patients who are discharged more quickly. The lower right quadrant is characterized by the worst situation of lower occupancy, lower turnover and higher mortality, suggesting poor utilization and poor standard of care.

To control for the possibility that mortality was caused by a certain variation in patient mix, it would have been better to plot mortality at parity of surgery rate. It is assumed that hospitals with similar surgery rates have similar patient mixes and can be comparable in terms of death rates and costs. However, the numbers of operations reported by most hospitals were unreliable, because the same hospitals reported completely different numbers of operations from one year to the next. The unreliability of this indicator is confirmed by its lack of correlation with cost per day and mortality. These findings suggest that the reporting of the number of operations is poorly standardised. Some hospitals may report only major operations while others may report all minor interventions and this pattern may vary from year to year.

The situation of the district hospitals can be summarized by two extremes. On one side, there are hospitals like Vryheid and Northdale, which are efficient and have low mortality. On the other side, there are hospitals like Montebello and Mbongolwane that have both inefficiency and high mortality. The rest of the hospitals fall in between with variable combinations of occupancy, turnover, cost per equivalent patient day and mortality.

Table 2 Indicators for District hospitals in FY01/02

District	Hospital	Occupancy	Turnover	Cost per day	Death rate
Amajuba	Niemeyer	38	3	508	9
eThekwni	Osindisweni	72	2	401	11
	McCords	44	4	439	5
	St Mary's (Marianhill)	96	6	432	9
iLembe	Montebello	31	2	856	10
	Umphumulo	60	2	610	8
	Untunjambili	*	*	*	8
Sisonke	Christ King	55	3	474	7
	EG Usher	37	3	736	7
	St Apollinnaris	71	4	486	9
	Tayler Bequest	74	4	511	9
Ugu	GJ Crooke's	51	4	505	7
	Murchison	97	3	358	10
	St Andrew's	61	3	405	7
uMgungundlovu	Appelsbosch	63	2	460	11
	Northdale	71	6	445	7
Umkhanyakude	Bethesda	99	4	716	9
	Hlabisa	106	3	345	9
	Manguzi	80	2	498	9
	Mosvold	62	3	576	7
	Mseleni	85	3	537	9
Umzinyathi	Charles Johnson	30	2	**	5
	Church of Scotland	104	3	450	7
	Dundee	46	3	687	8
	Greytown	46	3	484	6
Uthukela	Emmaus	48	4	595	6
	Estcourt	64	4	489	6
Uthungulu	Catherine Booth	67	3	481	7
	Ekombe	81	2	1003	8
	Eshowe	61	3	464	7
	Mbongolwane	47	1	664	10
	Nkandla	60	2	609	6
	KwaMagwaza	64	3	409	9
Zululand	Benedictine	51	2	709	9
	Ceza	61	2	718	7
	Itshelejuba	77	4	358	7
	Nkonjeni	67	3	756	9
	Pongola	27	4	387	2
	Vryheid	70	5	553	6
Average		**64**	**3**	**533**	**8**

* Excluded ** missing

Figure 7 District hospitals, efficiency in FY01/02

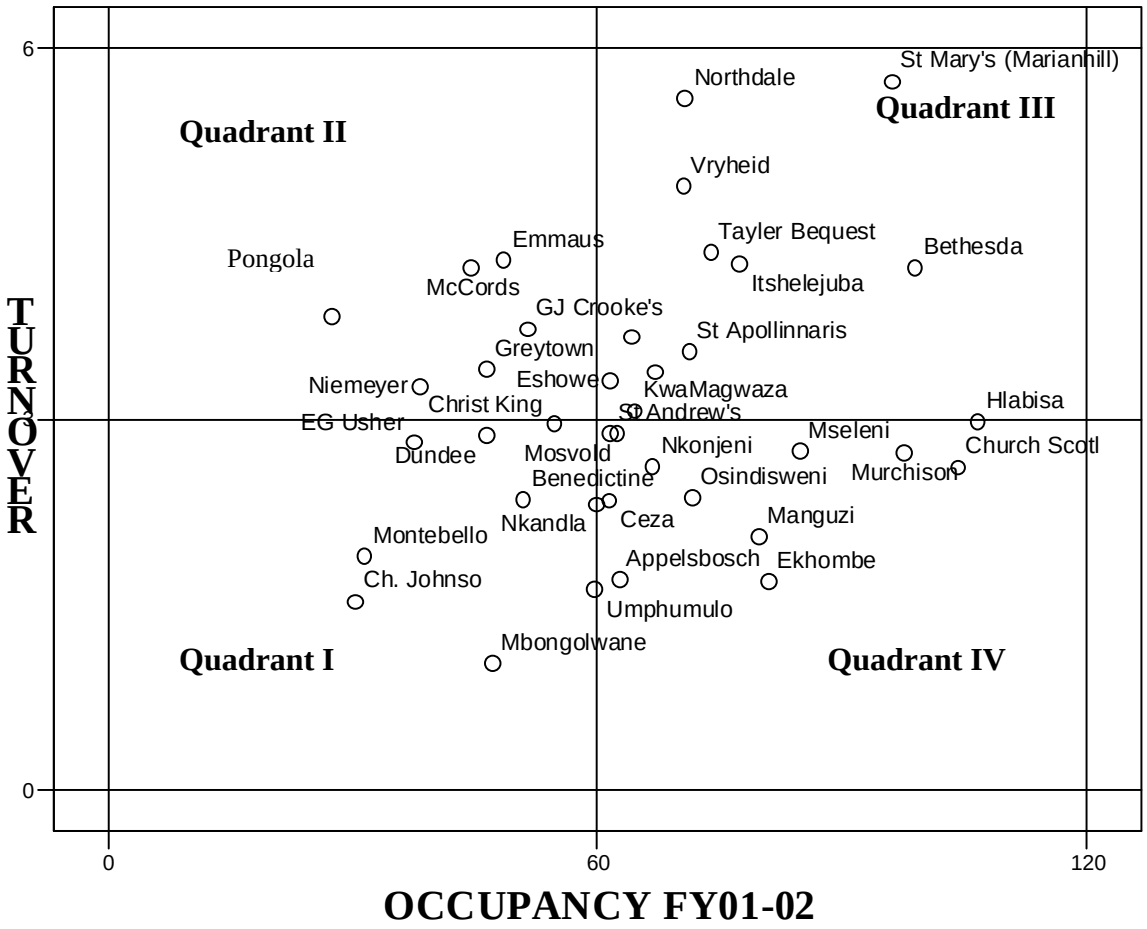


Figure 8 District hospitals, cost per day in FY01/02

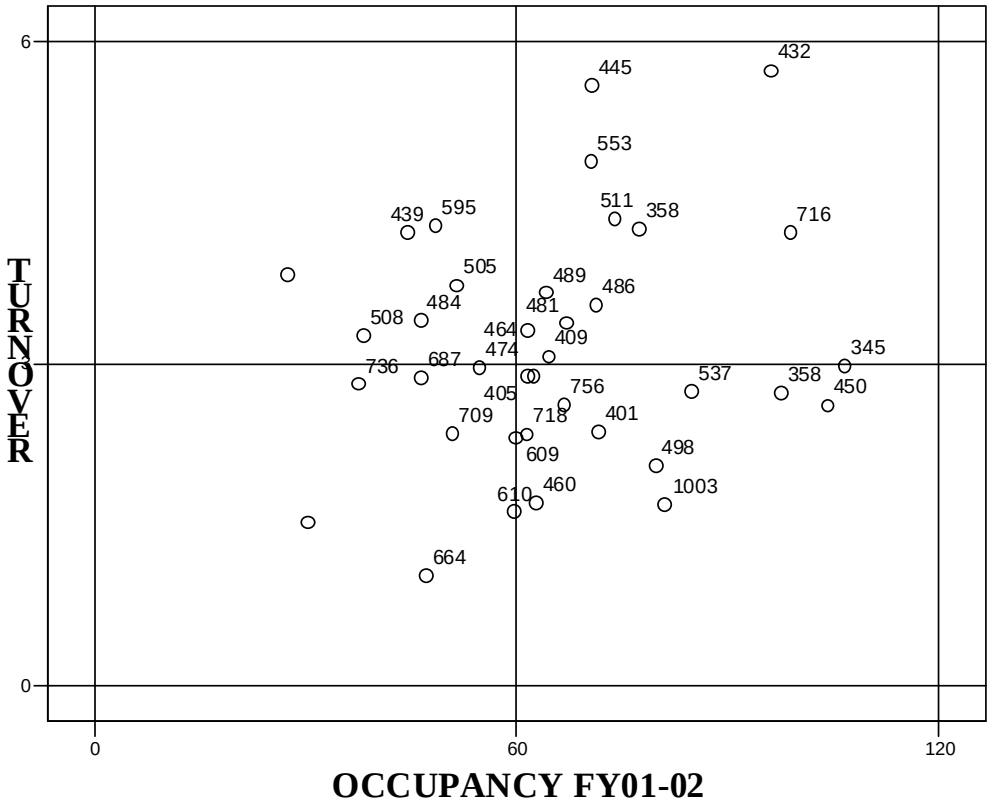
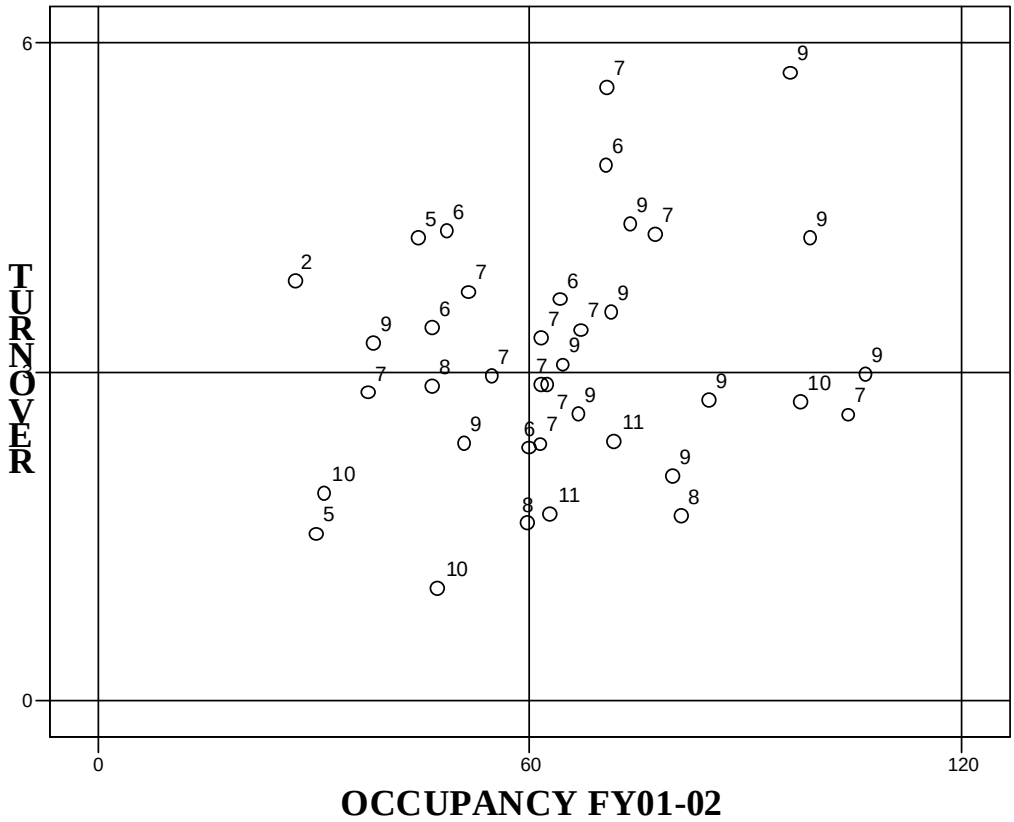


Figure 9 District hospitals, proportional mortality in FY01/02



Discussion

The data produced by the health information system need to be checked for consistency before being interpreted. The DOH has a clear responsibility in checking the reliability of the data coming from the hospitals and a lax attitude on this side is not acceptable because the publication of wrong data does not bode well for the credibility of the DOH. Some hospitals could have been identified as problematic even at a superficial assessment of the raw data on admissions, discharges, deaths, beds and inpatient days. The central level should have been more active by involving the Provincial Information Coordinators (PICs) and the Facility Information Officers (FIOs) in validating the reported data. The central level should have involved the managers to ensure that they allowed the FIOs to dedicate sufficient time to complete these simple and time-consuming tasks. Because the central level has failed to be proactive and the FIOs are frequently involved in many other tasks, this validation has not been done. The DOH will have to find alternative solutions to ensure that the data are regularly checked, validated and corrected. When this will be done, it is likely that some of the data presented in this issue will be changed. Nonetheless, even if the data will be changed, this issue has provided a methodology on how to check the reliability of the data reported from the hospitals and how to interpret the indicators.

The first recommendation is therefore to conduct an evaluation of the validity and the reliability of the health information system by comparing the data reported with the data recorded in the ward registers. This will help to understand the reasons behind the unreliability of the data and to identify which variables are misreported most. If for example, it will be found out that day patients and transfers are more frequently misreported, they could be eliminated from the formulae, which could be changed as follows:

- Occupancy = Inpatients days in a year/(365 * usable beds) * 100
- ALOS= Inpatients days in a year/(discharges + deaths in a year)
- Bed Turn over per year[6]=(Annual numbers of discharges + deaths) /usable beds
- Death rates[7] = deaths in a year/(discharges + deaths in a year)

The Pabon Lasso technique should be used at the peripheral and central levels to visualize hospital efficiency. The visual position of the hospitals on the graph facilitates the understanding of the relationship between the raw data and the efficient use of resources. The plotting of other indicators would enhance the differentiation of the hospitals in different profiles, but indicators such as the surgery rates need to be verified and validated before being used. The central level can use these profiles to generate hypothesis to be discussed and verified with the managers. It is only after the central level has played its crucial role in the analysis of the data that the managers can be involved in shedding light on the possible reasons for low efficiency.

[6] To be noted that at the moment the turnover rate is per month and not per year, as it is presently calculated in the HIS, this formula should be divided by 12.

[7] To be noted that the DOH has always used deaths/admissions, which is incorrect because the sum of "discharges + deaths" are used as proxy of the number of inpatients for the other indicators.

References

Health Statistical; Information. 1st April 2002 to 31st March 2003. Compiled by the Informatics Directorate. DOH 2004.

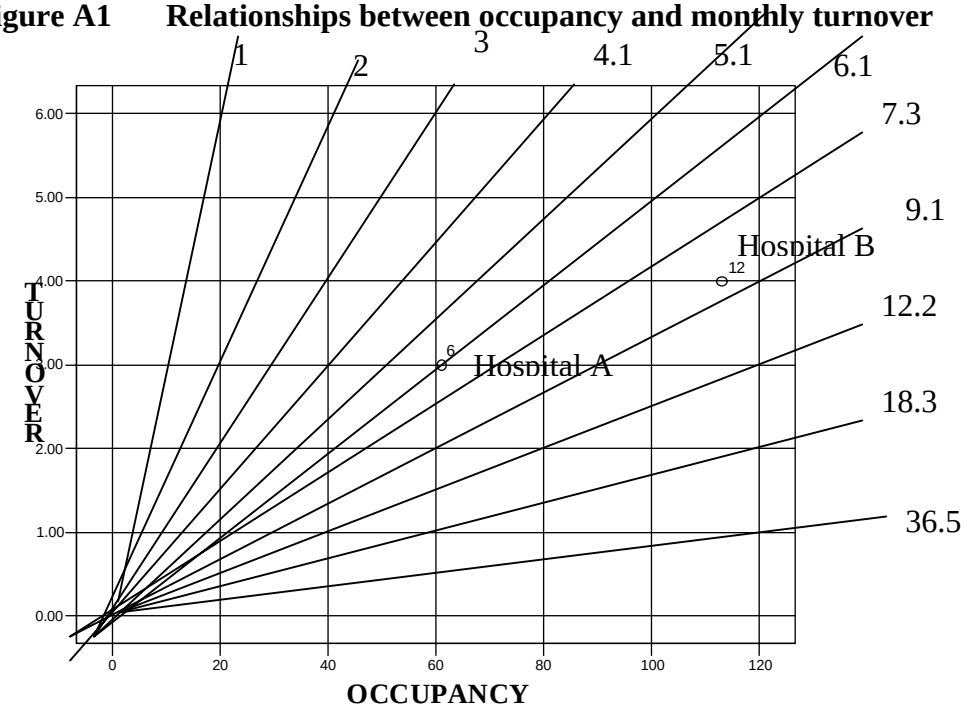
Barnum H and Kutzin J. Public Hospitals in Developing Countries. Resource Use, Cost, Financing. The John Hopkins University Press 1993.

Annex A Correct calculation of the hospital indicators

Common problems affecting the hospital indicators include miscalculation and unreliability. The analysis was therefore divided into the following steps: (a) check on the correct estimation of the indicators published in the latest annual Health Statistical Information[8]; (b) assessment of the reliability of the raw data on usable beds, inpatient days, discharges and deaths reported between FY00/01 and FY02/03; and (c) recalculation of the indicators and their interpretation in terms of efficiency. Annex A deals with the step (a), Annex B deals with step (b) and Annex C deals with step (c).

The possibility that indicators can be miscalculated should not be overlooked. Although, the use of the raw data on beds, inpatient days, deaths and discharges to calculate the indicators may seem straightforward, the possibility of getting the math wrong is not a remote possibility. Therefore, it is advisable to check that the indicators have been properly calculated before using them. This can be done through a visual representation of the indicators, which is adapted from Barnum and Kutzin[9]. Figure A1 shows that hospital A is positioned according to its occupancy rate of 60% (X axis) and turnover rate of 3 patients per month (Y axis); while the number '6' besides its position represents its monthly ALOS in days. Similarly, hospital B is positioned on the graph according to its bed occupancy rate slightly above 110% and its turnover of 4 patients per month; while its monthly ALOS is 12 days. The straight lines represent the constant ALOS that are expected at given values of occupancy and turnover rates.

Figure A1 Relationships between occupancy and monthly turnover



* Adapted from Barnum and Kutzin

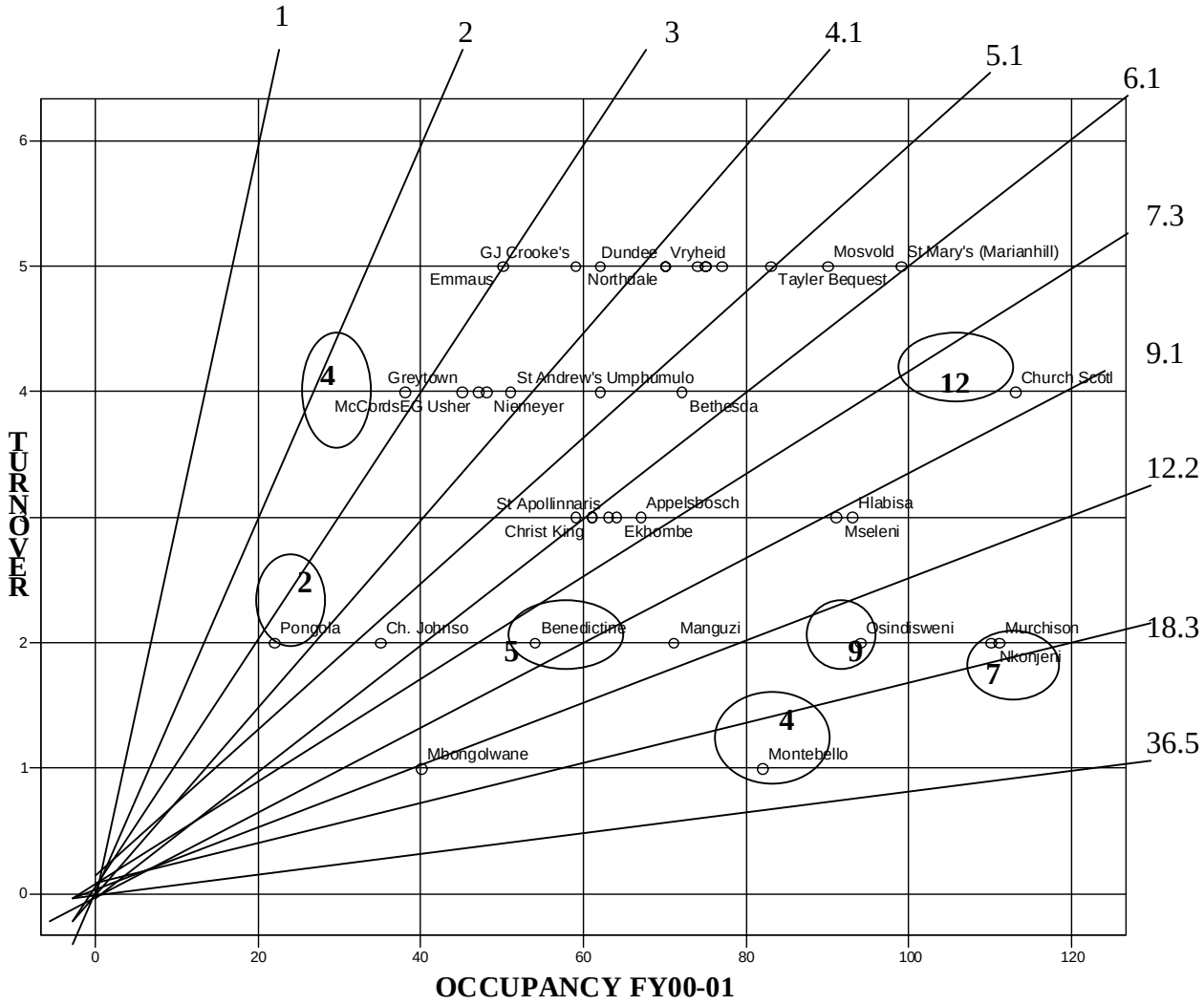
[8] Health Statistical Information. Informatics Directorate. DOH 2004.
[9] Barnum H and Kutzin J. Public Hospitals in Developing Countries. Resource Use, Cost, Financing. The John Hopkins University Press 1993.

For example, the straight ALOS line 6.1 starts at the origin where X and Y axes meet and passes through several combinations of occupancy and turnover rates. The 6.1 constant ALOS line crosses the graph at the intersection of occupancy 20% and monthly turnover 1, occupancy 40% and turnover 2, occupancy 60% and turnover 3 and so on. This means that any of the above combinations of capacity and turnover rates must be associated with an ALOS of about 6 days for the indicators to be consistent. For example, hospital A has an ALOS of 6 days, which is what is expected at such occupancy and turnover rates, as indicated by the ALOS line (6.1) on which hospital A lies. Hospital B on the other hand has an ALOS of 12 days, which is well beyond the nearest ALOS lines just before (7.3) and after (9.1) its position on the graph. Because it would be impractical to draw all the possible expected ALOS lines, only a few lines have been drawn. Therefore, at least one of the indicators for hospital B is wrong because its ALOS is outside the interval 7.3-9.1 indicated by the ALOS lines on its left and on its right. This means that the indicators of hospital B need to be recalculated.

The graphic technique depicted in Figure A1 is a visual tool to identify hospitals with miscalculated indicators. Because of the inter-relationship between occupancy, turnover and ALOS, knowing two indicators is sufficient to define the third one. It is for this reason that it is possible to draw straight ALOS lines departing from the origin, where the X and Y axes meet, and crossing the graph at defined intersections of occupancy and turnover rates. The Facility Information Officer and the manager can easily plot their hospital on the graph reproduced in Figure A1 according to its occupancy and turn over. If the hospital ALOS falls within the interval indicated by the nearest constant ALOS lines, the indicators are correct, otherwise they need to be recalculated. This technique can be also used at the centre to ensure that the math is done correctly.

Figure A2 shows how this technique was applied to the indicators published in the last annual report "Health Statistical Information" to identify hospitals with incorrect indicators. Figure A2 represents the position of the hospitals according to the indicators reported for FY00/01, with hospitals surrounded by a circle having incorrect indicators. For example, Montebello is positioned on the graph according to its occupancy rate of 82% and its monthly turn over rate of 1, while the number 4 besides the dot is its ALOS. At such occupancy and turnover rates, the ALOS should have been between 18 and 36, which are the two ALOS lines surrounding Montebello. Because the ALOS for Montebello was 4 days, at least one of the three indicators was miscalculated. The other hospitals with major miscalculation were Nkonjeni, Church of Scotland, Osindisweni, Benedictine, Pongola and McCord. After recalculation of the indicators, the problems disappeared and the ALOS were within the expected intervals. The same exercise was conducted for FY01/02 and FY02/03.

Figure A2 District hospitals with wrong indicators in FY00/01



Annex B Data Reliability

The recalculation of the indicators fixed the problem related to the incorrect use of the numerator and the denominator, but this has nothing to do with the reliability of the indicators. A correct calculation of the indicators can still produce unreliable indicators if the raw data on beds, inpatients days and other variables are unreliable. A reliable measurement of a variable (i.e. beds) provides the same value when its measurement is repeated under identical conditions. For example, if the number of beds in a hospital remains at 300 across the years, a reliable reporting will consistently provide 300 beds all the time, while an unreliable reporting will provide different numbers when the measurement of beds is repeated. Therefore, the unreliability is caused by the variation with which people count the same number of beds across periods of time.

Unreliable reporting of just one variable (i.e. beds) causes unreliable indicators. If there are no real changes but the reported number of beds is unreliable, the occupancy and turnover will have false fluctuations due to the fact that the unreliable numbers of beds affect the denominator of these indicators. Reliability is important because it allows to conclude that a change in numbers is real and not due to mis-reporting of the same number. A reliable reporting is critical to compare changes across periods of time even if the reporting is not valid. Reliability is not to be confounded with validity, for example an instrument could have high reliability but low validity if it gives consistent lower or higher values compared to the real value. This is the case of a hospital having had 300 beds in the last four years and having reported 250 beds all the time. The measurement was reliable because it provided the same lower value consistently across years but it was not valid because the reported value was not the real one. Therefore, reliability is extremely important to compare changes across time, while validity is important to know the real values.

Table B1 compares the numerators and the denominators of the main indicators according to what is commonly used internationally and according to what is suggested by the DOH. It should be clear from the previous paragraphs that if the way of counting the number of beds, inpatient days and other parameters changes in different directions across periods of time, the indicators will change in different directions too even if there are no real changes. This will create problem in the interpretation of what is going on in the utilization of the hospitals across years.

Table B1 Formulae of the hospital indicators

Indicator	Common definition*	DOH
Occupancy	Inpatient Days/ (365*usable beds)	(1/2 Day patient + Inpatient Days + transfers- in)/ (usable beds*day in a month/year)
ALOS	Inpatient Days/ (discharges+deaths)	(1/2 Day patient + Inpatient Days + Transfers-in)/ (Discharges + Deaths + Transfers out)
Turnover	(discharges+deaths)/ (usable beds)	(Discharges+ deaths + Transfer out)/ (usable beds)

* In the original reference of Barnum & Kutzin discharges or admissions are used as proxy of the number of inpatients.

The difficult task of ensuring the reliability of the indicators is likely to increase with the number of extra variables that are added at the numerators and the denominators. The subjective interpretation of transfers in, transfers out and day patients may increase the likelihood of inconsistent reporting. These variables may be interpreted differently among the nurses and the Facility Information Officers, and the different degree of compliance in reporting such data may lead to comparability problems across hospitals and within the same hospitals. Transfers in may be counted by some hospitals as admissions, other hospitals may report day patients as outpatients, some hospitals may count transfers out as discharges and so on. In other words some hospitals may rigorously comply with the reporting instructions for the numerators and the denominators; other hospitals may comply partially for one or the other indicator, others may not comply at all.

The data suggest problems of comparability across years for some hospitals because of likely changes in the way data were reported in different periods of time. The data summirised in Tables B2 and B3 suggest that most hospitals changed their pattern of reporting between the period FY00/01-FY01/02 and FY02/03. The last column provides comments on the quality of the raw data coming from each hospital and on their influence on the reliability of the indicators.

For example, the comments related to Montebello district hospital help to clarify the reason for the inconsistent indicators reported in FY00/01. The raw data for Montebello shows an increase in beds from 66 to 164 between FY00/01 and FY01/02. Such unlikely increase is inconsistent with its decrease in discharges from 5015 to 3383 and its relatively stable numbers of admissions, inpatient days and deaths between the two years. Because it is highly unlikely that the beds have almost tripled between the two years, while discharges have decreased and other variables have remained relatively stable, the most likely explanation is that beds were under-reported in FY00/01.

The under-reporting of the beds for Montebello in FY00/01 caused unlikely variation in occupancy. The under-reporting of beds in FY00/01 created a false high occupancy and high turnover rates in FY00/01 because the number of inpatient days (occupancy) and the number of discharges + deaths (turnover) were divided by an unrealistic low number of beds. ALOS, which results from the division of the number of inpatient days by the discharges + deaths, is not influenced by the under-reported beds and therefore becomes not consistent with the other two indicators. The over-estimation of occupancy rate is confirmed by the fact that the 82% occupancy reported in FY00/01 dropped to a more realistic 44% in FY01/02 and remained around that level in FY02/03. Therefore, the data related to Montebello for FY00/01 are not reliable and they should be corrected through validation. This can be done by comparing the data reported against the manual counting of the data recorded in the wards' registers.

Table B2 Data reliability across District hospitals

DISTRICT	Hospital	Comment
Amajuba	Niemeyer	The unlikely sharp decline in admissions and discharges between FY01/02 and FY02/03 is inconsistent with the much smaller decline of inpatient days between the two years.
EThekwini	Osindisweni	Between FY01/02 and FY02/03 the number of admissions were reduced by almost half, from 8628 to 4578. This is inconsistent with the increase in discharges and the relatively stable inpatient days across all years. Comparability problems are likely between the FY00/01- FY01/02 and FY02/03.
	McCord	Data seems to be reliable.
EThekwini	St Mary (Marianhill)	The fact that in FY02/03 deaths were only 321 compared with 1247 of FY01/02 is highly unlikely and inconsistent with the changes in beds, admissions and discharges.
EThekwini	Wentworth	The misreporting of beds caused unreliable variation in occupancy of 67% in FY00/01, 96% in FY01/02, and 43% in FY02/03.
iLembe	Montebello	The sharp increase in beds between FY00/01 and FY02/03 is inconsistent with the decline in discharges and relatively stable inpatient days. Between FY00/01 and FY01/02 beds increased from 66 to 164, discharges declined from 5015 to 3383; while admissions, inpatient days and deaths remained relatively stable. These inconsistent data led to an unlikely decrease in occupancy rate by half and to an unlikely sharp increase in mortality rates. There were inconsistencies also for FY02/03. Between FY01/02 and FY02/03 beds increased from 164 to 200, admissions dropped from 4168 to 2928, inpatient days increased and deaths remained stable.
	Umphumulo	Inconsistent data between FY01/02 and FY02/03. Beds dropped from 159 to 113, admissions increased from 3306 to 4493, discharges remained stable, deaths jumped up from 254 to 521 and inpatient days remained stable. The above changes are likely to be related to changes in reporting which make FY00/01 - FY01/02 not comparable with FY02/03.
iLembe	Untunjambili	The numbers of discharges and beds in FY02/03 are substantially lower compared with FY00/01. This is inconsistent with the changes in the numbers of inpatient days and deaths.
Sisonke	Christ the King	Data reporting appears different in FY00/01 - FY01/02 compared with FY02/03.
	EG Usher	The data look unreliable because of the wide variation in opposite direction of all the parameters across years.
Sisonke	St Apollinaires	The wide fluctuations in the number of deaths are inconsistent with the much lower variation in the other parameters and makes deaths unreliable for all the years. Beds, admissions, discharges and inpatient days seem comparable across years.
	Taylor Bequest	The substantial decline in the number of beds in FY01/02 might have been the result of misreporting, as suggested by the fact that in fY02/03 beds returned to the number of FY00/01.
Ugu	Crooke's	The number of beds and inpatient days were relatively stable during the four years but the data on the other parameters were different in FY00/01-FY01/02 compared with FY02/03.
	Murchison	The substantial decline of the inpatient days reported in FY02/03 is inconsistent with the much lower decline in discharges, admissions and deaths. This causes comparability problems between the very high occupancy in FY00/1 - FY01/02 and the much lower occupancy in FY02/03.

Cont.

DISTRICT	Hospital	Comment
	St Andrew's	Any comparison of occupancy and turnover across years should take into account likely overestimation of discharges and underestimation of inpatient days in FY00/01.
uMgungundlovu	Appelsbosch	Likely comparability problems between the first two years and FY02/03.
	Northdale	Likely comparability problems between the first two years and FY02/03.
Umzinyathi	Charles Johnson	Due to the high variability of all parameters in opposite directions, the data looks unreliable.
	Church Scotl	The high increase in the number of beds in FY02/03 is inconsistent with the decline in inpatient days and discharges. These changes are probably due to a different pattern of reporting which makes data reported in FY02/03 not comparable with the data reported in Y00/01 and FY01/02. This causes lack of comparability between the high occupancy around 100% in FY00/01 - FY01/02 and the occupancy in the order of 70% in FY02/03.
	Dundee	Data seem comparable across years, except for FY00/01 when discharges were much higher and could have been over-reported. This may be the reason behind the much higher occupancy of FY00/01 compared with the other years.
	Greytown	Likely problems of comparability between FY00/01- FY01/02 and FY02/03
Umkhanyakude	Bethesda	The wide changes in occupancy and turnover across years suggest unreliability of reporting.
	Hlabisa	Unlikely drop in discharges from 12554 to 6209 between FY01/02 & FY02/03. The wide changes in occupancy and turnover across years suggest unreliability of reporting.
	Manguzi	Except for mortality in FY00/01, the data looks reliable.
	Mosvold	The yearly changes are quite unlikely and inconsistent, causing wide variations in occupancy and turnover rates. Between FY01/02 and FY02/03 there was an unlikely decline in the numbers of discharges (from 7698 to 1750) and deaths (from 610 to 262), while beds declined only slightly from 239 to 194.
	Mseleni	The data suggest that unreliable reporting might be behind the inconsistent changes in deaths, inpatient days, admissions and discharges reported in FY02/03. Between FY01/02 and FY02/03 beds increased from 177 to 190, while admissions dropped from 5652 to 3459 and deaths declined from 519 to 170. These inconsistent data caused problems of comparability between the occupancy of 86% in FY01/02 and 42% in FY02/03.
Uthukela	Emmaus	The relatively stable number of inpatient is inconsistent with the substantial decline in discharges recorded in FY02/03.
	Estcourt	Likely overestimation of discharges in FY00/01 causes comparability problems across years.
Uthungulu	Catherine Booth	The gradual decline in all the variables is inconsistent with the increase in the number of beds and it may be the cause behind the unlikely sharp decline in occupancy and turnover across years.
	Ekombe	Between FY01/02 and FY02/03 admissions were almost halved & discharges remained stable. The data suggest lack of comparability between the higher occupancy of 64%-81% in FY00/01-FY01/02 and the much lower occupancy of 41% in FY02/03.

Cont.

DISTRICT	Hospital	Comment
	Eshowe	Data seems comparable across years, except for likely over-reporting of discharges in FY00/01, which were 26533 and declined to about 17000 during the following years. The over-reporting in FY00/01 is suggested by the much lower admissions reported in FY00/01. In FY00/01, discharges were 26533 against 18535 admissions.
Uthungulu	Mbongolwane	The change in the number of beds between the first two years and FY02/03 is inconsistent with the relative stability of the other parameters. This is probably due to reporting problems of beds in the two periods. This creates problems of comparability between the change in occupancy between the first two years and FY02/03. Avoid comparisons between the two periods.
	Nkandla	The change in occupancy between FY00/01-FY01/02 and FY02/03 is likely to be due to an underestimation of the number of beds in FY02/03.
	KwaMagwaza	The decline in discharges in FY02/03 is inconsistent with the relative stability of the other indicators and might be due to unreliability in reporting. Avoid comparisons between the first two years and FY02/03.
Zululand	Benedectine	Avoid using FY02/03 because of likely over-reporting of beds and uunlikely decline in discharges. This might be the reason why occupancy declined sharply in FY02/03.
Zululand	Ceza	The high variation in the parameters is likely to be due to misreporting. Between FY01/02 & FY02/03, while beds and admission remained stable, discharges dropped from 5229 to 2036, inpatient days declined from 44788 to 26118 and deaths were reduced from 409 to 247. The first two years and FY02/03 are characterized by completely different patterns of reporting, which make the two periods not comparable. This is the likely reason why occupancy was around 60% in the first two years and around 40% in FY02/03; and turnover was around 3 in the first two years and around 1 in FY02/03.
	Itshelejuba	The changes in the numbers of discharges and inpatient days look related to change in reporting between the first two years and FY02/03. This produces lack of comparability between the data reported for FY00/01-FY01/02 and FY02/03. This is likely to have caused the change in occupancy from 75%-77% in FY00/01-FY01/02 and 56% in FY02/03. The two periods should not be compared.
	Nkonjeni	The relatively stable number of admissions suggests under-estimation of beds in FY00/01. This is likely to have caused the change in occupancy from over 100% in FY00/01 to slightly less than 70% in FY01/02 and to 50% in FY02/03. Also monthly turnover dropped from 5 in FY00/01 to 3 in FY01/02 and to 1 in FY02/03.
	Pongola	The high yearly variation in the indicators does not allow any comparison across years.
	Vryheid	Unreliable data for FY02/03 because of unlikely drop in all the indicators. Between FY00/01 and FY01/03 there were the following unlikely substantial changes: inpatient days from 67893 to 24533, discharges from 14568 to 7324 and deaths from 928 to 156. These are clearly due to data reporting problems.

Table B3 Data reliability across Regional and Central hospitals

DISTRICT	Hospital	Comment
Amajuba	Madadeni	The doubling of the number of inpatient days between FY00/01 - FY01/02 and FY02/03 is likely to be due to unreliable reporting, as suggested by the inconsistent decline in admissions and discharges between the two periods. Avoid using FY02/03 and avoid comparing FY02/03 with the first two years.
Amajuba	Newcastle	The substantial increase in beds reported in FY02/03 is inconsistent with the decline in admissions and discharges.
EThekwini	Addington	Data seems reliable.
	Gandhi	Data are likely to have comparability problems across years
	Pr. Mshiyeni	Data seem reliable.
	Khan	Data on discharges, deaths, and inpatient days seem reliable, although beds might have been slightly underestimated in FY01/02 and slightly overestimated in FY02/03.
Ilembe	Stanger	There is a high variation in the number of beds across years. The fluctuations in the reported numbers of beds in opposite direction compared with the changes in the other variables suggest unreliability of the data. Avoid comparisons across years.
Ugu	Port Shepstone	The slight decline in admissions and discharges in FY02/03 is inconsistent with the stability in the numbers of inpatient days and beds. This variation is probably related to a change in reporting. FY02/03 should not be compared with FY00/01-FY01/02.
uMgungundlovu	Edendale	Between FY00/01 and FY01/02 there were unlikely fluctuations in discharges and deaths, which are inconsistent with the relative stability of the inpatient days and beds. Possible underestimation of discharges and deaths in FY00/01 and FY02/03. Avoid comparisons across years.
	Grey's	The decline in admissions and discharges between FY00/01 and FY02/03 is inconsistent with the relative stability of inpatient days, beds and deaths. The reporting of beds in the last year is completely different from the previous years, probably because of unreliable reporting. Avoid comparisons across years.
Uthukela	Ladysmith	Data are comparable across years with the exception of possible slight over-reporting of admissions and discharges in FY01/02.
Uthungulu	Ngwelezane	The variables look different between the first two years and FY02/03 possibly due to reporting problems. Avoid comparisons between the two periods.
	Lower Umfolozi	Avoid using FY00/01. The data suggest changes in reporting in FY02/03.

Annex C Hospitals ranked in order of efficiency in FY01/02[10]

Because of the problems described in Annex B, only FY01/02 was used to interpret hospital efficiency. The formulae for the recalculation of the indicators are those commonly used internationally and they are based on the use of the sum of "discharges + deaths" as proxy of the number of inpatients. The transfers in, transfers out and the day patients were not included because of their high unreliability and because they add very little to occupancy rate and turnover. The formulae used in this issue were the followings:

- Occupancy=inpatient days/(usable beds*365)
- ALOS=inpatient days/(discharges+deaths)
- Turnover=(Discharges + deaths)/(usable beds)
- Mortality rate=deaths/(discharges+deaths).

This Annex provides a ranking of the hospitals in terms of efficiency in FY01/02. The ranking is based on the comparison of the indicators against the average for the hospital category.
The signs define the higher than average (+), average (+/-) and lower than average (-) values.

[10] Source: Health Statistical Information, DOH, 2004

Table C1 District hospitals ranked by efficiency in FY01/02

DISTRICT	Hospital	Occupancy	Turnover	Cost per day	Mortality
uMgungundlovu	Northdale	+	+	-	-
Zululand	Itshelejuba	+	+	-	-
Sisonke	St Apollinaire	+	+	-	Unreliable
Ethekwini	St Mary (Marianhill)	+	+	-	+
Sisonke	Tayler Bequest	+	+	+/-	+
Zululand	Vryheid	+	+	+	-
Umkhanyakude	Bethesda	+	+	+	+
Umzinyathi	Church of Scotland	+	+/-	-	-
Ugu	Murchison	+	+/-	-	+
Umkhanyakude	Hlabisa	+	+/-	-	+
Umkhanyakude	Mseleni	+	+/-	+/-	+
Umkhanyakude	Manguzi	+	-	-	+
Ethekwini	Osindiweni	+	-	-	+
Uthungulu	Ekombe	+	-	+	+/-
Uthukela	Estcourt	+/-	+	-	-
Uthungulu	Eshowe	+/-	+/-	-	-
Ugu	St Andrew	+/-	+/-	-	-
Uthungulu	C Booth	+/-	+/-	-	-
Uthungulu	KwaMagwaza	+/-	+/-	-	Unreliable
Umkhanyakude	Mosvold	+/-	+/-	+	-
Zululand	Nkonjeni	+/-	+/-	+	+
Umgungundlovu	Appelsbosch	+/-	-	-	+
Uthungulu	Nkandla	+/-	-	+	-
Zululand	Ceza	+/-	-	+	-
Ilembe	Umphumulo	+/-	-	+	+/-
Ethekwini	Mc Cord	-	+	-	-
Zululand	Pongola	-	+	-	-
Ugu	GJ Crooke's	-	+	+/-	-
Uthukela	Emmaus	-	+	+	-
Sisonke	Christ the King	-	+/-	-	-
Amajuba	Niemeyer Mem	-	+/-	+/-	+
Umzinyati	Greytown	-	+/-	+/-	-
Sisonke	Usher Mem	-	+/-	+	-
Umzinyati	Dundee	-	+/-	+	+
Zululand	Benedictine	-	-	+	+
Ilembe	Montebello	-	-	+	+
Uthungulu	Mbongolwane	-	-	+	+
Umzinyati	C Johnson Mem	-	-	Not available	-

*+ = Higher than average +/- = average - = lower than average

Table C2 Regional and Central hospitals ranked by Efficiency in FY01/02

DISTRICT	Hospital	Occupancy	Turnover	Cost per day	Mortality
eThekwini	Gandhi	+	+	-	+
eThekwini	Khan	+	+	+/-	-
Umgungundlovu	Grey	+	+	+/-	-
eThekwini	Addington	+	+	+	-
UThungulu	Lower Umfolozi	+	+	+	-
Ugu	Port Shepstone	+	+/-	+/-	+/-
UThungulu	Ngwelezane	+	+/-	+	+
iLembe	Stanger	+/-	+	-	+/-
eThekwini	King Edward	+/-	-	+/-	+/-
eThekwini	Prince Mshiyeni	+/-	-	+	+/-
Umgungundlovu	Edendale	+/-	-	+	+
Amajuba	Newcastle	-	+	+	-
Uthukela	Ladysmith	-	+/-	-	+/-
Amajuba	Madadeni	-	-	-	-
eThekwini	King George	-	-	-	-

*+ = Higher than average +/- = average - = lower than average