

# Regional Variation in Hospital Admission Rates in the Netherlands, Belgium, Northern France Nordrhein-Westfalen\*

M. van Noordt, J. van der Zee, P. P. Groenewegen  
Inst. of Primary Health Care, Utrecht, the Netherlands

## Regionale Unterschiede in Krankenhausaufnahmen in den Niederlanden, Belgien, Nordfrankreich und Nordrhein-Westfalen

In der Analyse über regionale Unterschiede bei Krankenhausaufnahmen wurde ein Modell verwendet, in dem Indikatoren sowohl für die Nachfrage wie auch für das Angebot enthalten sind. Regionale Daten wurden für vier Gesundheitsfürsorgesysteme gesammelt (Niederlande, Belgien, Frankreich und Deutschland), und zwar für die Jahre 1982, 1979 und 1974 (Frankreich nur 1982). Das Angebot an Krankenhausbetten erwies sich als wichtigster Faktor für die Erklärung der Varianz. Das französische Gesundheitsfürsorgesystem und, wenn auch im geringeren Ausmaß, das deutsche erwiesen sich als die am stärksten vom Angebot dominierten Systeme der genannten vier Staaten. Diese Charakteristik des deutschen Systems hat im Laufe der Zeit an Bedeutung eingebüßt. Wir folgern daraus, daß die empirische Generalisierung, wie im Roemerschens Gesetz zum Ausdruck kommt (A bed built is a bed filled), hinsichtlich Zeit und Raum konditioniert ist. Hypothesen in bezug auf den konditionalen Charakter des Roemerschens Gesetzes bedürfen einer eingehenderen Prüfung.

## Introduction

Until recently, the supply of hospital beds has been considered the major determinant of (regional) variation in hospital admission rates. In the comprehensive bibliography of Coulter et al. (1), this is one of the main conclusions. Roemer's law; 'A bed built is a bed filled' was regarded as one of the few universal and law-like statements in the domain of health care research. Recently van Doorslaer und van Vliet (2) questioned the universality and causality of the association of hospital beds and admission rates, but they clearly form an exception.

From a series of internationally comparative studies (Belgium and the Netherlands, Belgium, the Netherlands and Northern France) with regional data about supply and demand factors, from several years (1974, 1979, 1982) Groenewegen and van der Zee (3,4) concluded that the influence of bed supply on the utilization of hospital services

## Summary

For the analysis of regional variations in hospital admission rates a model was set up, including both supply and demand indicators. Data were gathered for regions in four health care systems (the Dutch, Belgian, French and German), for 1982, 1979, 1974 (France 1982 only). Hospital bed supply proved to be the key factor in the explanation of the variation. The French health care system and, to a lesser extent, the German, turned out to be the strongest supply-dominated health care systems of the four. However, supply dominance in the German health care system seems to decrease over time. We concluded that the empirical generalisation, contained in Roemer's law, a bed built is a bed filled, is conditioned by time and place. Hypotheses on the conditional character of Roemer's law require further testing.

## Key words

Hospital admission rates – International comparison – Regional variation

might be less universal and more dependent on time and place than the literature would suggest.

They found decreasing degrees of supply-dominance in the period 1974–1982 in the Netherlands and considerable differences between the three countries in the study, France having the most strongly supply-dominated health care system of the three. By introducing a fourth region (the German Bundesland of Nordrhein-Westfalen) with data from 1974, 1979 and 1982 the degree of universality of Roemer's law could be tested once again. The research question in this paper is: What is the relative influence of hospital bed supply, health status and some other possible determinants on the use of hospital facilities in four different health care systems (Belgium, the Netherlands, the North of France and Nordrhein-Westfalen) in the period 1974–1982. As Northern France data were available only for 1982, the first part of the paper deals with the international comparison between the four countries in 1982, while

in the second part data for Nordrhein-Westfalen, Belgium and the Netherlands for 1974, 1979 and 1982 are analysed.

### Hypotheses

The structure of the analysis is derived from a scheme developed by the Canadian health economist Evans, who stated that the use of health services is a function of supply and need factors under the legal and financial conditions of a health care system (5).

In our research model we included variables that are either indicators of the demand for health care or can be considered to be supply factors. We hypothesize that the demand for health care is a function of the health status and the socio-economic position of the population concerned. The health status of the population is indicated by the age-adjusted death rates and the proportion of persons of 65 years and older. The socio-economic composition of a region is a parameter, indicating the propensity to seek medical care. In this respect, income distribution rates are part of the research model. Lastly, population density rates were used, indicating the degree of urbanization. This factor has been included because of cultural differences between the rural and (sub)urban population and the presence of hospital facilities (distance bias).

The influence of the supply side on the explanation of differences in hospital admission rates is indicated by the number of hospital beds and the average length of stay per admission. *Gloerich et al.* (4) demonstrated that these variables contributed largely to the explained variance in the number of hospital admissions in Northern France (88%). The supply and demand variables mentioned are considered to influence hospital admission rates irrespective of a specific health care system. One can also think of specific characteristics of a health care system, contributing to the explanation of regional differences in admission rates.

*Glaser* (1970) already pointed to the effect of the remuneration system of physicians on the flow of patients. The referral rate for general practitioners with capitation payment is expected to be higher, compared to those remunerated on a fee-for-service basis. Because the income of a gp with capitation payment is irrespective of the number of services rendered by gp (the number of services only influence their amount of free time), the system implies an incentive for gp's to refer the patient to the hospital (6). In Belgium, France and West Germany ambulatory physician services are generally reimbursed on a fee-for-service basis. In the Netherlands only privately insured (about 30% of the population in 1982) pay the general practitioner on a fee-for-service basis. The publicly insured pay a capitation fee. Hospital-based physicians are salaried by the hospital in France and the FRG. Belgian and Dutch hospital specialists receive a fee-for-service.

Also, the accessibility of physicians is critical in determining a referral to a hospital (7). Specialist care in the FRG is characterized by a strict division between ambulatory and hospital-based specialists. Ambulatory specialistic care is directly accessible, whereas hospital specialists (who only treat patients in the hospital) are accessible by referral only (8).

Belgian and French medical specialists can work in both an ambulatory and hospital setting. They are both

directly accessible. The Dutch health care system is exceptional in this respect; access to both outpatient and inpatient specialistic medical care is by referral from a general practitioner only. Thus, the gp in the Dutch health care system functions as a gatekeeper to the secondary health care sector. In the West German health care system both gp's and ambulatory specialists have this function. In Belgium and France the concept of the division between the first and the second echelon is not based on the referral system; all medical specialists are directly accessible. However, direct access is most common to so called popular specialists (pediatricians, gynaecologists and internists). These popular specialists are considered to be primary health care physicians in the analysis. With respect to these differences between the four health care systems concerned, we expect a lower hospital admission rate in regions with a relatively high number of primary health care providers. However, the actual decision-making process of primary health care providers is based on a mix of factors. These cannot be directly related to the variables used in this study, because of the high level of aggregation. Our conclusions, therefore, have to be restricted to this high aggregation level.

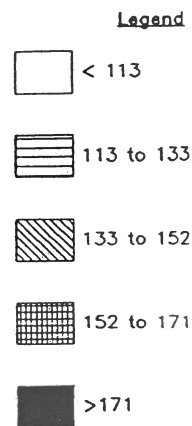
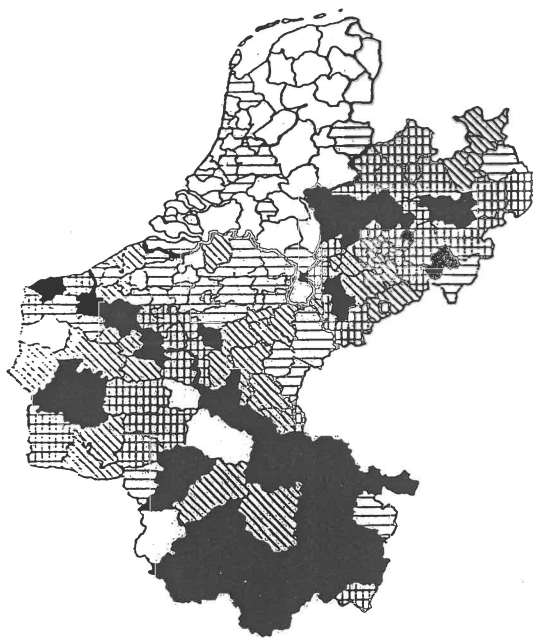
One remaining point of difference, that is relevant in the analysis deals with the number of home deliveries. In the Netherlands 35.4% (CBS, 1982) of all deliveries take place at home (if it comes to an admission, this usually involves a very short hospital stay, which is not counted as an admission), whereas in Belgium, France and the FRG home delivery is an exception. Regional differences in birth rates may, therefore, have less influence on hospital admission rates in the Netherlands than in the other health care systems. The variable birth rate is used to correct for this characteristic of the Dutch health care system.

### Data and method of analysis

For our study data were collected on a regional level, i.e. 43 COROP regions in the Netherlands, 42 arrondissements in Belgium, 44 secteurs sanitaires (health care regions) in Northern France and 54 Kreise in Nordrhein-Westfalen. Most of the data are derived from the Central Bureau of Statistics (CBS) in the Netherlands, the National Institute of Statistics (NIS) in Belgium, the Centre de Recherches Economiques Sociologiques et de Gestion (CRESGE) in France and Das Landesamt für Datenverarbeitung und Statistik Nordrhein-Westfalen in Nordrhein-Westfalen. More details on the resources of the data will be described in a following comprehensive study in the series of internationally comparative studies, published by the Dutch Institute of Primary Health Care (NIVEL).

The analysis of variation in hospital admission rates on a regional level is a tool for extending the number of units of analysis in order to compare just a small number of health care systems. The number of units of analysis in the regional analysis is large enough to make statistical analysis possible. Moreover, regional analysis permits the examination of data for populations, which tend to be more homogeneous in character than are populations examined at a national level (1).

The method of analysis used is the least squares regression analysis, in which the hospital admission rate per 1000 of the population forms the dependent variable. The independent variables of the model include variables that are either indicators of the demand for health care or can be



**Fig. 1** Geographical distribution of hospital admission rates in the Netherlands, Belgium, Northern-France and Nordrhein-Westfalen, 1982 (admissions/1 000 inhabitants).

considered to be supply factors. The variables included (two excepted) are expected to influence hospital admission rates irrespective of differences between the four health care systems. The first exception is the variable birth rate, which is used to correct for a characteristic of the Dutch health care system and secondly the number of primary health care physicians, which is used because of differences in access to specialistic care.

### Descriptive results

Table 1 shows the variation of the dependent variable in the regression model (hospital admission rates per 1 000 inhabitants) between and within the four research areas. The highest hospital admission rates are found in Northern France, followed by Nordrhein-Westfalen. Belgian rates are somewhere in between, whereas the Dutch rates are relatively low.

More interesting is the question how hospital admission rates vary *within* different health care systems, in other words; to what extent do these rates differ between regions within Nordrhein-Westfalen, the Netherlands, Belgium and Northern France? Table 1 also shows that regional differences in hospital admission rates are highest in Northern France. Regional variation in the other study-areas is significantly lower.

The geographical distribution of regions with high or low hospital admission rates in different health care systems can be visualized most effectively by means of a map. Corresponding to the conclusions of Table 1, the map shows that regional variation in admission rates is highest in Northern France. The highest rates can be found in the eastern part of Northern France (the district of Lorraine), in the district of Amiens and various districts in the borderland of France and Belgium. The districts Ardennes-Sud, Romilly Sezanne and Lille show relatively low admission rates. The highest rates in Belgium are found in the district of Charleroi and the lowest ones in the districts of St. Nikolaas and Dendermonde. In the

**Table 1** Variation in hospital admission rates in 1982.

	NR-WF	Nethl.	Belgium	N-Fr.
hospital admission rates per 1 000 inh.	162	107	137	174
regional variation (sd/mean)	0.10	0.10	0.14	0.34

Netherlands, hospital admission rates are relatively low, with small regional differences. The independent variables will be discussed here briefly by presenting the mean and standard deviation of the variables used, as well as the 1982 index rates of the mean, compared to 1974. (1974 data for Northern France were not available.) (Table 2)

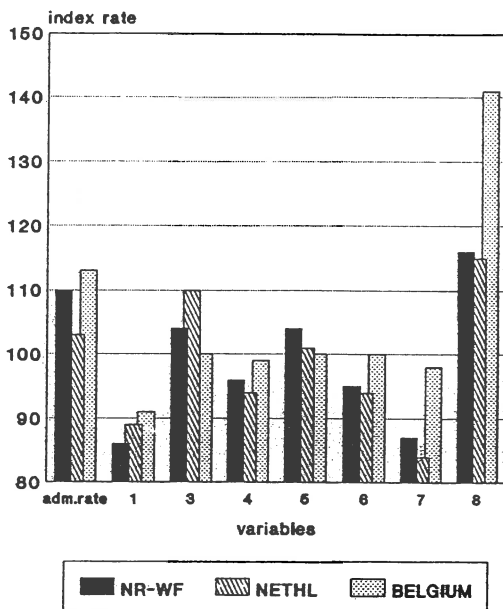
The effects of bed reduction policies in the seventies and eighties in the West German and Dutch health care system are clearly shown. Nordrhein-Westfalen still has the highest rate (8.03 in 1982). According to the index rates in Belgium the number of hospital beds did not change in the period 1974–1982. However, bed supply increased until 1979 but has displayed a decreasing trend since then. In the primary health care sector, the number of physicians increased to a very large extent.

### Analytical results of 1982 data

The regression model seems to perform best in Northern France and Nordrhein-Westfalen, with respectively 88 % and 65 % explained regional variation in admission rates (Table 3). In the next step, the significantly explanatory variables were included in the regression analysis (Table 4). The new regression model includes the variables number of beds per thousand inhabitants, mean stay, mortality and the number of primary health care providers. The variables income and birth rate (significantly explanatory variables in Nordrhein-Westfalen) are excluded because these variables correlate highly

**Table 2** Mean and standard deviation of the variables in the regression model, 1982.

	$\bar{x}$	NR-WF SD	$\bar{x}$	the Nethl. SD	$\bar{x}$	Belgium SD	$\bar{x}$	N- France SD
1. age-adjusted death rate	9.86	(0.62)	8.13	(0.55)	9.83	(0.91)	9.42	(0.77)
2. income distribution	-0.00	(1.00)	0.00	(1.00)	0.01	(0.99)	-0.01	(1.00)
3. proportion 65 +	14.24	(1.79)	11.48	(2.38)	13.97	(2.00)	12.82	(1.97)
4. population density	1 080.87	(958.28)	679.51	(806.41)	463.35	(910.11)	163.80	(205.00)
5. birth rate	10.11	(1.04)	15.05	(2.23)	13.51	(0.93)	15.71	(1.42)
6. nb. of beds 0/00	8.03	(2.26)	4.30	(0.78)	4.81	(2.17)	5.35	(1.47)
7. mean stay	14.98	(1.21)	12.51	(1.48)	13.71	(3.98)	8.77	(1.16)
8. primary h.c. phys. 0/00	0.92	(0.23)	0.39	(0.03)	1.17	(0.19)	0.80	(0.25)
GP's 0/00	0.37	(0.06)	0.39	(0.03)	0.94	(0.16)	0.72	(0.18)
Common/amb. spec 0/00	0.55	(0.21)	N. A.	N. A.	0.23	(0.12)	0.08	(0.04)
hosp.-based spec 0/00	0.45	(0.22)	0.53	(0.28)	0.55	(0.31)	0.37	(0.16)



NIVEL 1991

**Fig. 2** Index-rates of the mean of the hospital admission rate and the independent variables in the regression model, 1982 (1974 = 100). The numbers of the variables correspond to the numbers in Table 2.

with the number of primary health care providers, especially ambulatory specialists. In this reduced regression model, the total explained variance is more or less the same.

The supply of hospital beds is an explanatory variable in all four health care systems, although a remark has to be made about the very low explanatory power of the model in the Netherlands and Belgium. With respect to Northern France data, we conclude that 89% of regional variation in hospital admission rates in this area can be explained by the supply of hospital beds and the average length of stay per admission. Apparently, the relatively high bed density and the relatively short length of stay in this area induces the demand for hospital treatment. Nordrhein-Westfalen data show that variables on both the supply and demand side of the model con-

**Table 3** Regression on the number of hospital admission 0/00 in Nordrhein-Westfalen, the Netherlands, Belgium and Northern-France in 1982. Presented are B-coefficients and (T-statistics).

variables	NR-WF	N-France	the Nethl.	Belgium
<i>demand-side</i>				
mortality	<u>10.82</u> (4.09)	0.94 (0.15)	<u>7.26</u> (2.00)	4.89 (1.41)
income	5.01 (2.27)	3.13 (0.73)	1.93 (0.65)	-1.26 (-0.32)
prop. 65 +	-1.09 (-1.00)	-2.00 (-0.82)	-0.60 (-0.55)	3.15 (1.61)
pop. density	0.004 (1.60)	0.01 (0.70)	-0.003 (-0.98)	0.0002 (0.07)
birth rate	<u>5.64</u> (2.23)	-0.41 (-0.13)	-1.32 (-0.95)	5.37 (1.19)
<i>supply-side</i>				
nb. of beds 0/00	<u>3.95</u> (4.34)	<u>29.35</u> (11.15)	5.38 (1.95)	2.30 (1.61)
mean stay	2.33 (1.28)	<u>-23.43</u> (-7.81)	0.60 (0.37)	-0.46 (-0.74)
prim. phys. 0/00	<u>-22.91</u> (-2.01)	22.69 (1.19)	22.62 (0.40)	19.02 (1.07)
constant	-35.74 (-0.59)	225.40 (2.40)	38.11 (0.63)	-54.55 (-0.69)
adjusted R <sup>2</sup>	0.64	0.89	0.19	0.26

\* : p &lt; 0.05

-- : 0.05 &lt; p &lt; 0.10

tribute to the explanation of regional variation in admission rates.

The influence of the primary health care physicians is relevant only in Nordrhein-Westfalen; the more general practitioners and ambulatory specialists per 1 000 inhabitants, the fewer hospital admissions take place. We can understand this result if we take into account the strict division between ambulatory and hospital specialistic care and the fact that more than half of all primary health care providers in Nordrhein-Westfalen are specialists. Moreover, these specialists are most often well equipped with all the necessary facilities for diagnostic tests and treatment (9). As a consequence, they can, to a certain extent, form a substitute for hospital-based physicians.

**Table 4** Regression\* on the number of hospital admissions 0/00 in Nordrhein-Westfalen, the Netherlands, Belgium and Northern-France in 1982, including four variables. Presented are B-coefficients and (T-statistics).

variables	NR-WF	N-France	the Nethl.	Belgium
nb. of beds 0/00	<u>3.55</u> (3.69)	<u>30.24</u> (13.08)	<u>6.28</u> (2.72)	2.56 (1.93)
mean stay	1.75 (1.01)	<u>-24.64</u> (-9.24)	0.83 (0.74)	0.51 (-0.88)
mortality	9.61 (3.76)	2.42 (0.60)	<u>7.76</u> (2.62)	6.09 (1.90)
prim. phys. 0/00	<u>-19.48</u> (-2.10)	19.21 (1.41)	15.53 (0.33)	20.86 (1.55)
constant	30.38 (0.76)	190.34 (3.63)	1.06 (0.03)	47.55 (1.52)
adjusted R <sup>2</sup>	0.56	0.89	0.23	0.24

\* -: p &lt; 0.05

--: 0.05 &lt; p &lt; 0.10

### Results of the analysis over time

In the last part of the analysis, the question is raised how the results of the regression model with 1982 data relate to the results in previous years. A previous study (3) with data of Belgium and the Netherlands on three different points in time, 1974, 1979 and 1982, showed a diminishing influence of the bed supply on the admission rates. The results of the regression analysis with data of Nordrhein-Westfalen (including the four most explanatory variables) correspond to these results.

The influence of bed-supply is no longer significantly explanatory in 1982 in Belgium. Recent data might show a disappearance of this influence.

### Discussion and conclusions

The above-mentioned review of the literature (1) and various studies since then (10,11) pointed to the predominant influence of supply factors on the use of hospital facilities. The more hospital beds provided, the more hospital beds being used does indeed prevail in Northern France and to a lesser extent in Nordrhein-Westfalen, the Netherlands and Belgium. The explanatory power of the variable bed-supply, however, decreased during the period 1974-1982. This trend might give an indication of the dynamics of a health care system during a period of change from an expanding hospital sector to a decreased growth of the hospital sector (12,13). At the end of the seventies, health care policies in most OECD countries shifted from cost expansion to cost control. As a consequence, bed reduction policies were carried out to control the high level of health care expenditures in these countries.

Bed capacity decreased in the period 1974-1982 in the Netherlands and Nordrhein-Westfalen (Figure 2). In Belgium bed capacity has decreased only since 1979. Recent data might show the continuing decrease in bed supply and most probably a disappearance of the influence on hospital admission rates in the regression model. In conclusion, Roemer's law (a bed built is a bed filled) (14) applies to a certain degree to all four health care systems but is conditioned by place and time. The hypothesized influence of primary health care physicians on the regional variation in hospital admission rates was found in Nordrhein-Westfalen only. The

**Tab. 5** Regression\* on number of hospital admissions 0/00 in Nordrhein-Westfalen, the Netherlands and Belgium in 1974, 1979 and 1982. Presented are B-coefficients and (T-statistics).

	1974	1979	1982
<i>NR-WF</i>			
nb. of beds 0/00	<u>5.66</u> (7.50)	<u>3.63</u> (4.79)	<u>3.55</u> (3.69)
mean stay	<u>-2.58</u> (-2.59)	1.31 (0.96)	1.75 (1.01)
mortality	6.89 (3.62)	<u>10.29</u> (3.67)	<u>9.61</u> (3.76)
prim. phys. 0/00	-30.75 (-3.69)	-7.44 (-1.41)	<u>-19.48</u> (-2.10)
constant	89.66 (3.29)	9.08 (0.29)	30.38 (0.76)
adjusted R <sup>2</sup>	0.67	0.53	0.56
<i>the Netherlands</i>			
nb. of beds 0/00	<u>13.71</u> (4.51)	<u>12.66</u> (4.09)	<u>6.28</u> (2.72)
mean stay	<u>-2.77</u> (-2.25)	<u>-3.38</u> (-2.12)	0.83 (0.74)
mortality	3.53 (1.24)	1.88 (0.54)	<u>7.76</u> (2.62)
prim. phys. 0/00	52.79 (0.94)	45.42 (0.86)	15.53 (0.33)
constant	33.39 (0.93)	65.57 (1.61)	1.06 (0.03)
adjusted R <sup>2</sup>	0.33	<u>0.28</u>	<u>0.23</u>
<i>Belgium</i>			
nb. of beds 0/00	<u>3.25</u> (2.54)	<u>5.75</u> (3.02)	<u>2.56</u> (1.93)
mean stay	0.98 (0.76)	-0.03 (-0.09)	-0.51 (-0.88)
mortality	1.16 (0.34)	6.15 (1.56)	<u>6.09</u> (1.90)
prim. phys. 0/00	-1.12 (-0.07)	17.67 (1.16)	20.86 (1.55)
constant	80.05 (1.73)	17.50 (0.44)	47.55 (1.52)
adjusted R <sup>2</sup>	0.12	<u>0.22</u>	<u>0.24</u>

\* -: p &lt; 0.05

--: 0.05 &lt; p &lt; 0.10

negative influence of this variable in the regression model corresponds to the idea of a counterbalance effect of the primary health care sector versus the hospital sector (3,4,15). The West German health care system is characterized by a steady trend towards an increasing proportion of specialistic care in the primary health care sector. Moreover, the strict boundary between ambulatory and hospital care and the fee-for-service remuneration system in the primary health care sector involve an incentive for ambulatory specialists to treat patients in their own practice. However, this statement needs to be analysed at a lower aggregation level.

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M. van Noordt

Inst. of Primary Health Care  
P. O. Box 1568  
NL-3500 BN Utrecht

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F. Beske, Kiel

Wendt, M., H. van Aken, Th. Prien (Hrsg.): **Qualitätssicherung in der Intensivmedizin**. 24. Münsteraner Anästhesiesymposium. INA-Schriftenreihe, Band 78. 1991. 76 S., 13 Abb., 7 Tab. (Georg Thieme Verlag Stuttgart · New York.) Kart. DM 49,00. ISBN: 3 13 773201 8

Die Broschüre enthält die 12 Vorträge des 24. Münsteraner Anästhesiesymposiums vom 19.–20. Januar 1990. Behandelt werden Grundsatzfragen der Qualitätssicherung, Qualitätsstandards aus der Sicht des Pflegepersonals, räumliche Konzeptionen, Hygienestandards, Monitoring, Datenverarbeitung, Wirtschaftlichkeitsfragen und juristische Probleme. Qualitätssicherung, wie sie heute verstanden wird, ist kaum Gegenstand der Beiträge. Es wäre jedoch wünschenswert, wenn auch in der Intensivmedizin Maßnahmen zur Qualitätssicherung entwickelt werden würden.

F. Beske, Kiel