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### Ethnic inequalities in patient safety in Dutch hospital care

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# Chapter 2

**Ethnic variations in unplanned readmissions  
and excess length of hospital stay:  
a nationwide record-linked cohort study.**

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## ABSTRACT

### Background

Studies in the USA have shown ethnic inequalities in quality of hospital care, but in Europe, this has never been analysed. We explored variations in indicators of quality of hospital care by ethnicity in the Netherlands.

### Methods

We analysed unplanned readmissions and excess length of stay (LOS) across ethnic groups in a large population of hospitalized patients over an 11-year period by linking information from the national hospital discharge register, the Dutch population register and socio-economic data. Data were analysed with stepwise logistic regression.

### Results

Ethnic differences were most pronounced in older patients: all non-Western ethnic groups > 45 years had an increased risk for excess LOS compared with ethnic Dutch patients, with odds ratios (ORs) (adjusted for case mix) varying from 1.05 [95% confidence intervals (95% CI) 1.02–1.08] for other non-Western patients to 1.14 (95% CI 1.07–1.22) for Moroccan patients. The risk for unplanned readmission in patients >45 years was increased for Turkish (OR 1.24, 95% CI 1.18–1.30) and Surinamese patients (OR 1.11, 95% CI 1.07–1.16). These differences were explained partially, although not substantially, by differences in socio-economic status.

### Conclusion

We found significant ethnic variations in unplanned readmissions and excess LOS. These differences may be interpretable as shortcomings in the quality of hospital care delivered to ethnic minority patients, but exclusion of alternative explanations (such as differences in patient- and community-level factors, which are outside hospitals' control) requires further research. To quantify potential ethnic inequities in hospital care in Europe, we need empirical prospective cohort studies with solid quality outcomes such as adverse event rates.

## INTRODUCTION

High-income countries are multi-ethnic societies in which ethnic diversity has been increasing and will continue to increase in the coming decades. There is ample evidence for ethnic inequalities in health and health outcomes. There are numerous causes for ethnic inequalities in health, and differences in quality of care could potentially contribute to this. For example, in the USA, empirical evidence has been found for ethnic inequalities in quality of care in treatment for cancer and acute myocardial infarction.[1,2] In Europe, hypertension control among people undergoing treatment appears to be worse among black people than among other ethnic groups.[3,4]

For the past 2 decades, unplanned readmission rates and excess length of stay (LOS) have been put forward as indicators of efficiency and quality of hospital care in the USA. The relationship between readmission rates and excess LOS and quality of care is complex, and has been studied frequently.[5–15] A recent systematic review showed that the median proportion of readmissions deemed avoidable was 27%, but variability between studies was large, and the authors concluded that the true proportions remain unclear.[5] This suggests that factors other than quality of hospital health care play a role, such as differences in patient- and community-level factors, which are outside the hospital's control. Because reducing LOS may lead to higher readmission rates, in which case low LOS might indicate poor quality of care, these indicators should always be assessed together.[15]

Understanding ethnic variations in readmission rates and excess LOS is a prerequisite for using these measures as quality of care indicators across ethnic patient groups.[16–19] Figure 1 presents a conceptual model to interpret ethnic differences in excess LOS and unplanned readmissions, based on our previously published conceptual model for ethnic differences in patient safety (figure 1).[20] The model consists of patient diversity characteristics, organisational cultural competence and effective or ineffective patient–provider interaction, which may lead to appropriate or inappropriate excess LOS and unplanned readmissions.

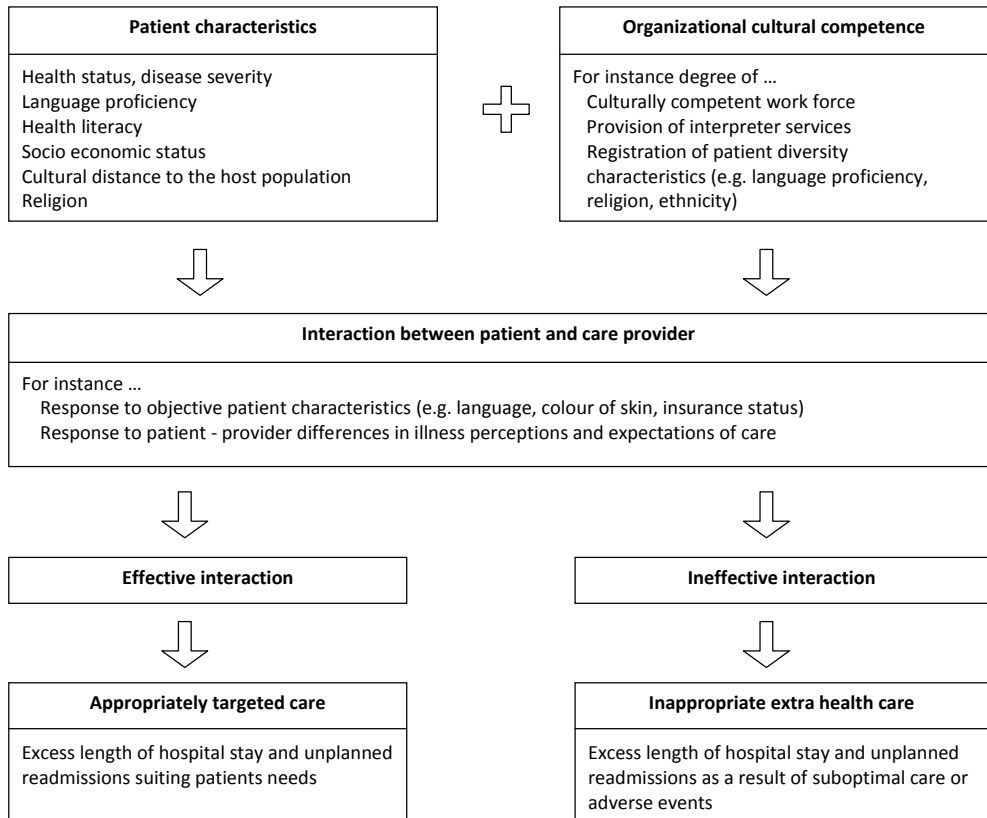
Ethnic variations in patient characteristics and consequential care needs may justify ethnic variations in care consumption.[21] For example, ethnic variations in the severity of chronic illness can lead to variations in health care consumption, if those in poorer health receive more thorough disease management.[22] Also in the Netherlands, ethnic minorities report poorer health and higher health care consumption.[3,4,23] Additionally, patient-related factors such as low mastery of the language and cultural distance to the majority population or low socio-economic status (SES) may be associated with increased requirements of nursing care.[24–28] In such situations, ethnic variations in readmission rates and excess LOS may reflect appropriate care for ethnic minority patients. On the other hand, health care may fall short and things can go wrong in the interaction between health care providers and patients from different ethnic backgrounds. For instance, if a black thread is used to stitch a wound in a black skin in a hospital mainly treating white patients. This is an inappropriate response

to an objective patient characteristic, which increases the risk of incomplete removal of the stitches later on, because of low contrast in colours.

European research relating ethnic variations in outcomes of care to the care process is scarce. Irrespective of the interpretation, studies on ethnic differences in readmission rates and excess LOS in the USA have shown conflicting results. Joynt (2011) showed that black patients had higher readmission rates within 30 days compared with white patients [odds ratio (OR) 1.13] for three common conditions.[27] Also, patients in 'minority-serving hospitals' had higher readmission rates than patients in 'non-minority-serving hospitals' (OR 1.23). Jencks showed an increased risk for readmission among ethnic minorities (OR 1.06),<sup>29</sup> while Deswal showed equal readmission rates for black and white veterans.[30]

We are unaware of any European study on ethnic differences in unplanned readmission rates or excess LOS.[31] Because the European health care system differs from the American health care system, results from the USA cannot easily be generalized. Moreover, international differences in the operationalization of ethnicity hamper generalizability of USA study results. In the Netherlands, ethnic origin as indicated by country of birth criteria is commonly used as ethnicity indicator. This is common practice in continental Europe, whereas in the UK, self-identified ethnicity is preferred and in the USA, race/ethnicity.[32]

We analysed unplanned readmissions and excess LOS across ethnic groups in a large population of hospitalized patients in the Netherlands over an 11-year period. We assessed to what extent ethnic variation was explained by disease severity and socio-economic status. In addition, we hypothesized an increased risk of unplanned readmissions and excess LOS among first-generation ethnic minority patients, because patient characteristics such as cultural distance to the host population and low proficiency of the language of the host country tend to be more pronounced in first than in second-generation ethnic minority patients.



**Figure 1.** Conceptual model of ethnic variation in excess length of hospital stay and unplanned readmission

## METHODS

### *Study population*

We constructed a cohort of patients hospitalized in all Dutch hospitals between 1 January 1995 and 31 December 2005 by linking information from the national hospital discharge register (HDR), the Dutch population register (PR) and socio-economic data from Statistics Netherlands. Appendix 1 provides information on the HDR and PR databases.

### *Linking the HDR and PR*

The HDR is a database on admissions, not individuals. HDR data are coded by professional coders based on patient records. Following individuals over time based on HDR information alone is troublesome, owing to difficulties in identifying different admissions for the same person with regard to time and admission for the same condition at a different hospital. However, linkage with the PR solves the majority of these problems. More than 97% of the uniquely linked hospital admissions resulting from linking the HDR with the PR were shown to be correctly linked.[33] A random sample of all hospital admissions registered in the HDR has recently shown that 99% of the personal, admission and discharge data and 84% of the principal diagnoses (validated through medical record review by medical specialists) were correctly registered.[34]

We excluded specialized hospitals (because of their highly specific patient population), obstetrics-related admissions (because of insufficient possibilities for adjusting for patient mix), patients who died during hospital admission (because they could not be readmitted, making the expected LOS hard to estimate) and migrant patients from Western countries (to maximize the contrast with the ethnic Dutch patients from our analyses).

### *Assessing ethnicity*

The ethnic groups were classified according to country of birth and the country of birth of the parents, in accordance with the Statistics Netherlands definition.[35] Ethnic Dutch persons are defined as those whose parents were both born in the Netherlands. First-generation migrants are those who were born outside the Netherlands and with at least one parent who was born abroad. Second-generation ethnic non-Dutch are those who were born in the Netherlands with at least one parent born outside the Netherlands.

Ethnic groups are divided into Western and non-Western groups. The main non-Western groups in the Dutch population (16 million inhabitants in 2005) include Surinamese (329 430 persons in 2005), Antilleans/Arubans (130 538 persons in 2005), Turkish (358 846 persons in 2005), Moroccans (315 821 persons in 2005) and other non-Western groups (564 407 persons in 2005).

Surinam is a former Dutch colony. Most Surinamese people speak Dutch. The Surinamese population is ethnically highly diverse, and consists mainly of people who originate from West Africa, South Asia and those of mixed origin. From 1975 onwards, many Surinamese

people moved to the Netherlands with their families, including both younger and older individuals.

The Antillean and Aruban population (the islands are also former colonies) is predominantly of West African, European and mixed origin, and migration to the Netherlands has been relatively stable over time. Most Antilleans speak Dutch. Many Antillean migrants moved to the Netherlands in the 1980s and 1990s to work and study.

Turkish and Moroccan men came to the Netherlands as labour migrants in the 1960s and 1970s and were later followed by their families. Neither group originally spoke Dutch. The other non-Western groups comprise people who came to the Netherlands from other parts of the world including China, South Asia, Sub-Saharan Africa, the Caribbean, the Middle East and South America.[32]

### ***Outcome measures, potential confounders and explanatory variables***

Unplanned readmission was defined as an urgent clinical hospitalization, which was not planned in advance, within 30 days of the initial clinical hospitalization, with duration of at least 24 h. Excess LOS was computed as the difference between observed LOS and the mean expected LOS. The expected LOS was estimated based on a generalized estimating equation model with a gamma distribution using STATA version 9, taking into account age (four classes), registration year (1995–2005), diagnosis (50 classes based on the ninth revision of the International Classification of Diseases, or ICD-9-CM), intervention (37 classes based on ICD-9-CM) and hospital ( $n = 139$ ), while accounting for clustering of LOS within patients.[36]

Data on patient characteristics related to need for health care (age, sex and case-mix variables: primary and secondary diagnosis), principle intervention and type of insurance were obtained from the HDR. The primary diagnosis was coded using ICD-9-CM and then classified according to the Clinical Classifications Software (CCS) into 12 homogenous diagnostic groups.[37] Co-morbidity was assessed by the Charlson Index, based on the secondary diagnoses registered for each admission in the HDR.<sup>38</sup> Primary intervention was classified according to ICD-9-CM main categories. Ethnic differences in SES constitute a potential explanation for ethnic variations in excess LOS and unplanned readmissions. Information on the SES of the neighbourhood of residence was derived from the Social and Cultural Planning Office of the Netherlands.<sup>35</sup> For the years 1994, 1998, 2002 and 2006, the social status of all neighbourhoods in the Netherlands was computed based on education, unemployment and income. In addition, insurance type was used as an indicator of SES. Insurance type was classified as private or social insurance. Private insurance indicates that a person has an income above the threshold for social insurance. Both types of insurance give access to identical health care facilities.

### ***Statistical analysis***

Owing to the large sample size and technical limitations of the software, we needed to reduce our data set. Therefore, Statistics Netherlands provided us with a random sample of ethnic Dutch admissions to arrive at roughly the same size as the other largest ethnic groups (283 379 of 18 262 091 admissions). We verified whether the random sample was



representative for the total Dutch population regarding age, sex, diagnosis, intervention and hospital of admission.

In the analyses of unplanned readmissions, we excluded patients who had never been admitted for >24 h. In the analyses of excess LOS, only admissions of >24 h were included. Based on the distribution of excess LOS, we chose to dichotomize hospital admissions with and without excess LOS using a threshold of 3 days excess LOS. We also performed sensitivity analyses with different threshold values for excess LOS in both absolute and relative measures (5 days, 7 days, 20%, 50% and 100% excess LOS).

Descriptive statistics of all clinical hospitalizations with duration of >24 h were calculated in SPSS 14.0 for each ethnic group.

We used stepwise logistic regression analysis to assess differences in the incidence of unplanned readmission within 30 days of a prior admission. In the first model, only ethnic group, age and sex were taken into account. In the second model, we examined the contribution of case mix, adding diagnosis, co-morbidity and primary intervention. In the third model, we examined the contribution of socio-economic indicators to the observed ethnic variations. The associations between these factors and the incidence of readmissions within 30 days were assessed by ORs with 95% confidence intervals (95% CI).

Analogously, a stepwise logistic regression analysis was applied to assess differences in excess LOS between ethnic groups, while first adjusting for patient mix and then for socio-economic indicators.

Because effect modification was present according to age regarding the ethnic differences in both unplanned readmissions and excess LOS across ethnic groups, we performed all analyses in two strata: patients  $\leq 45$  years and patients  $> 45$  years. This split was chosen after several sensitivity analyses and showed the most homogeneous samples with minimal interaction with age. We performed subgroup analyses for first- and second-generation patients of  $\leq 45$  years to assess the effect of ethnic generation. Non-Western patients  $> 45$  years were almost all first generation.

The data in this study were hierarchical: admissions (level 1) were nested within hospitals (level 2). Both patient populations and quality of care may differ between hospitals. Therefore, in a sensitivity analysis, we analysed the data with multi-level logistic regression analysis, in which variation in outcomes was apportioned to the patient admission and hospital level.<sup>39,40</sup> Based on the total variance, we calculated intra-class correlations (ICCs), which give an indication of the extent of the variance between hospitals. For example, a high ICC at hospital level means there is more homogeneity (low variation) within hospitals (patients are treated the same in individual hospitals), but high variation between hospitals. Sensitivity analyses showed that the amount of clustering at hospital level was small. With regard to readmission rates, the ICC values varied from 1.6–2.0%. For excess LOS rates, the ICCs varied from 0.1–0.7%. The ORs were affected minimally when clustering at hospital level was taken into account. Therefore, we report our results based on the stepwise logistic regression analyses.

## RESULTS

A total of 1 177 304 admissions for 433 501 patients in 139 hospital locations were included in our sample. In the original sample, ~95% of the patients were of ethnic Dutch origin; in the analysed sample, this was 24%. Most patients of ethnic non-Dutch origin were first generation, varying from 49% in Moroccan to 79% in Surinamese patients. Patients from ethnic minority groups were younger and suffered less often from cardiovascular diseases and neoplasms than their ethnic Dutch counterparts. SES was higher in the ethnic Dutch than in other ethnic groups (table 1).

An unplanned clinical readmission within 30 days of discharge occurred after 34 113 (2.9%) clinical admissions. An excess LOS of at least 3 days was present in 143 302 (17.5%) admissions. In patients of  $\leq 45$  years, without adjustment for case mix and socio-economic indicators, the risk of unplanned readmission within 30 days was 17–20% higher among Moroccan, Surinamese and Antillean patients, but not in Turkish patients compared with ethnic Dutch patients (table 2 and Supplementary table S1). After adjustment for case mix, the ethnic differences became smaller, resulting in a 9–13% increased risk of unplanned readmission in Moroccan, Surinamese and Antillean patients compared with the ethnic Dutch. After further adjustment for socio-economic indicators, there was only a slight additional decrease in the differences between ethnic minority groups and ethnic Dutch patients.

In patients  $>45$  years, the risk of unplanned readmission within 30 days was 10–32% higher in Antillean, Surinamese and Turkish patients than in ethnic Dutch patients (table 2). After adjustment for case mix, the ORs decreased for all ethnic groups, resulting in a 24% and 11% increased risk for Turkish and Surinamese patients, respectively, but not for the other groups. After further adjustment for socio-economic indicators, the differences for all ethnic groups compared with ethnic Dutch patients decreased slightly. However, Turkish patients still had a 19% higher unplanned readmission rate than ethnic Dutch patients, and Surinamese patients had an 8% higher unplanned readmission rate, which was not accounted for by socio-economic indicators.

The ethnic differences in risk of excess LOS of at least 3 days are presented in table 3 (and Supplementary table S2) for patients of  $\leq 45$  years. Similar to the results for unplanned readmission, the ethnic groups showed an increased risk overall, also after controlling for demographics and case mix. However, the ethnic differences appeared to be less pronounced than those for readmission. In addition, in contrast with unplanned readmissions, all ethnic groups showed an increased risk, including the Moroccan population. After further adjustment for socio-economic indicators, most of the increased risks remained in both age groups.

**Table 1** Characteristics of 1 177 304 admissions from 433 501 patients in 139 Dutch hospitals between 1 January 1995 and 31 December 2005 by ethnic group

	Dutch	Moroccan	Turkish	Antillean	Surinam- ese	Other non- OECD
Number of admissions (n)	283,379	111,265	226,598	73,489	241,168	241,405
First generation (%)		48.7	68.3	77.7	78.8	76.2
Sex (% male)	48.3	54.0	54.6	44.6	44.5	52.8
Age (%)						
1-17	7.2	46.9	26.7	18.2	13.5	26.1
18-30	6.3	25.4	18.5	17.1	12.0	16.9
31-40	8.4	15.4	17.9	18.9	16.8	20.5
41-50	11.9	7.1	13.6	18.5	20.3	17.2
51-60	15.9	3.5	13.4	14.8	16.1	10.0
61-65	8.7	1.0	5.7	4.6	6.6	3.1
>= 66	41.6	0.7	4.2	7.9	14.7	6.2
CCS diagnosis (%)						
Heart diseases	9.9	1.9	6.2	4.3	8.1	4.4
Neoplasms	8.2	2.2	3.2	4.2	3.8	3.7
Coma, shock	2.0	2.7	2.2	2.6	3.1	3.9
Septicaemia	0.1	0.1	0.1	0.2	0.2	0.1
Acute cerebrovascular disease	1.3	0.2	0.5	0.7	1.2	0.6
Diseases of the arteries, arterioles, and capillaries	2.2	0.3	0.7	0.9	1.1	0.6
Diseases of the respiratory system	3.8	3.7	3.5	3.1	3.4	3.2
Diseases of the digestive system	3.9	3.8	3.5	3.6	3.7	3.7
Diseases of the urinary system	0.8	0.9	1.2	1.4	1.5	1.2
Fractures	0.9	0.1	0.1	0.1	0.1	0.1
Intracranial injuries	0.6	1.5	0.9	1.0	0.7	1.1
Complications of surgical procedures	1.5	1.0	1.2	1.7	1.5	1.2
Other	64.7	81.6	76.8	76.1	71.4	77.0
Charlson Index (co-morbidity scale) >= 2 (%)	13.3	4.0	6.0	8.6	8.9	7.3
ICD-9 Procedures/interventions (%)						
No procedure/intervention	38.8	45.5	41.8	43.8	45.1	43.4
Operations on the eye	9.1	5.7	8.7	8.6	10.4	8.4
Other miscellaneous procedures	0.1	0.1	0.1	0.2	0.3	0.1
Operations on the ear	0.2	0.1	0.2	0.2	0.2	0.2
Operations on the respiratory system	1.7	0.7	1.1	1.1	1.2	1.0
Operations on the digestive system	18.8	21.6	22.3	16.3	16.7	19.9
Operations on the urinary system	23.5	21.1	20.3	24.6	20.5	21.3
Operations on the musculoskeletal system	1.7	2.0	1.9	1.5	1.3	1.7
Operations on the integumentary system	2.1	0.6	1.3	1.2	1.3	1.0
Misc. diagnostic & therapeutic procedures	3.9	2.4	2.4	2.7	3.0	2.9
Quartiles socio-economic position <sup>a</sup> (%)						
< 25%	39.1	14.9	12.1	25.3	23.1	27.0
26%-50%	33.8	21.0	22.2	23.3	18.3	24.8
51%-75%	18.8	30.9	31.4	26.1	23.0	24.6
> 75%	6.2	33.1	34.3	25.5	35.6	23.6
Private insurance (%)	29.1	6.9	6.1	18.0	16.0	17.2
Unplanned readmissions within 30 days (%)	3.3	2.5	2.7	3.1	2.8	2.6
Excess length of hospital stay >= 3 days (%)	19.6	14.6	15.8	17.5	18.9	16.5

a. A higher quartile is associated with a lower socio-economic score.

**Table 2** Differences in unplanned clinical readmission within 30 days after index admission in patients younger and older than 45 years and by ethnic generation, among ethnic groups in the Netherlands between 1 January 1995 and 31 December 2005

	Odds ratio <sup>a</sup> (95% CIs) Model 1	Odds ratio <sup>a</sup> (95% CIs) Model 2	Odds ratio <sup>a</sup> (95% CIs) Model 3
<b>Unplanned readmission in patients ≤ 45 years</b>			
Ethnicity (reference: ethnic Dutch patients) (n=203693)			
Moroccan (n=8927)	<b>1.20 (1.12-1.27)</b>	<b>1.13 (1.06-1.21)</b>	<b>1.12 (1.05-1.20)</b>
Turkish (n=66233)	1.02 (0.96-1.08)	1.00 (0.94-1.06)	0.98 (0.92-1.05)
Surinamese (n=112898)	<b>1.17(1.10-1.24)</b>	<b>1.09 (1.02-1.16)</b>	<b>1.08 (1.02-1.15)</b>
Antillean (n=26214)	<b>1.20 (1.11-1.29)</b>	<b>1.13 (1.04-1.22)</b>	<b>1.12 (1.04-1.21)</b>
Other non-Western groups (n=64414)	<b>1.09 (1.03-1.15)</b>	1.02 (0.96-1.08)	1.01 (0.95-1.07)
<b>Unplanned readmission in patients &gt; 45 years</b>			
Ethnicity (reference: ethnic Dutch patients) (n=203693)			
Moroccan (n=8927)	1.01 (0.89-1.14)	0.97 (0.85-1.10)	0.94 (0.83-1.06)
Turkish (n=66233)	<b>1.32 (1.26-1.38)</b>	<b>1.24 (1.18-1.30)</b>	<b>1.19 (1.13-1.25)</b>
Surinamese (n=112898)	<b>1.20 (1.15-1.24)</b>	<b>1.11 (1.07-1.16)</b>	<b>1.08 (1.04-1.13)</b>
Antillean (n=26214)	<b>1.10 (1.02-1.18)</b>	1.05 (0.97-1.27)	1.03 (0.95-1.10)
Other non-Western groups (n=64414)	<b>1.06 (1.01-1.12)</b>	1.03 (0.98-1.08)	1.01 (0.96-1.06)
<b>Unplanned readmission in first generation ≤45 years</b>			
Ethnicity (reference: ethnic Dutch patients)			
Moroccan	<b>1.10 (1.01-1.19)</b>	1.05 (0.96-1.13)	1.04 (0.95-1.13)
Turkish	0.95 (0.89-1.02)	0.94 (0.88-1.01)	0.93 (0.87-1.00)
Surinamese	<b>1.21 (1.13-1.29)</b>	<b>1.14 (1.06-1.22)</b>	<b>1.13 (1.06-1.21)</b>
Antillean	<b>1.31 (1.20-1.42)</b>	<b>1.23 (1.13-1.34)</b>	<b>1.22 (1.12-1.33)</b>
Other non-Western groups	<b>1.13 (1.07-1.21)</b>	<b>1.07 (1.01-1.14)</b>	<b>1.07 (1.00-1.14)</b>
<b>Unplanned readmission in second generation ≤45 years</b>			
Ethnicity (reference: ethnic Dutch patients)			
Moroccan	<b>1.35 (1.24-1.47)</b>	<b>1.24 (1.14-1.36)</b>	<b>1.23 (1.13-1.34)</b>
Turkish	<b>1.17 (1.08-1.27)</b>	<b>1.11 (1.02-1.20)</b>	1.09 (1.00-1.19)
Surinamese	<b>1.16 (1.06-1.26)</b>	1.06 (0.97-1.15)	1.05 (0.97-1.15)
Antillean	1.02 (0.90-1.16)	0.97 (0.85-1.10)	0.97 (0.85-1.10)
Other non-Western groups	1.04 (0.95-1.13)	0.95 (0.86-1.04)	0.94 (0.86-1.03)

a. Odds ratios that were statistically significant are printed in bold.

**Table 3** Differences in excess length of hospital stay in patients younger and older than 45 years and by ethnic generation, among ethnic groups in the Netherlands between 1 January 1995 and 31 December 2005

	Odds ratio <sup>b</sup> (95% CIs) Model 1	Odds ratio <sup>b</sup> (95% CIs) Model 2	Odds ratio <sup>b</sup> (95% CIs) Model 3
<b>Excess LOS<sup>a</sup> in patients ≤ 45 years</b>			
Ethnicity (reference: ethnic Dutch patients)			
Moroccan	<b>1.10 (1.06-1.13)</b>	<b>1.07 (1.04-1.11)</b>	1.03 (1.00-1.07)
Turkish	1.00 (0.97-1.03)	1.00 (0.97-1.03)	<b>0.96 (0.93-0.99)</b>
Surinamese	<b>1.17 (1.14-1.21)</b>	<b>1.10 (1.07-1.13)</b>	<b>1.08 (1.04-1.11)</b>
Antillean	<b>1.12 (1.08-1.17)</b>	<b>1.07 (1.03-1.11)</b>	<b>1.05 (1.01-1.09)</b>
Other non-Western groups	<b>1.12 (1.09-1.15)</b>	<b>1.09 (1.05-1.12)</b>	<b>1.06 (1.03-1.10)</b>
<b>Excess LOS<sup>a</sup> in patients &gt; 45 years</b>			
Ethnicity (reference: ethnic Dutch patients)			
Moroccan	<b>1.17 (1.09-1.25)</b>	<b>1.14 (1.07-1.22)</b>	<b>1.09 (1.02-1.16)</b>
Turkish	<b>1.13 (1.10-1.16)</b>	<b>1.10 (1.07-1.13)</b>	<b>1.04 (1.01-1.07)</b>
Surinamese	<b>1.13 (1.11-1.16)</b>	<b>1.08 (1.06-1.11)</b>	<b>1.04 (1.02-1.07)</b>
Antillean	<b>1.14 (1.10-1.19)</b>	<b>1.11 (1.07-1.16)</b>	<b>1.08 (1.04-1.13)</b>
Other non-Western groups	<b>1.07 (1.04-1.10)</b>	<b>1.05 (1.02-1.08)</b>	1.03 (1.00-1.05)
<b>Excess LOS in first generation ≤45 years</b>			
Ethnicity (reference: ethnic Dutch patients)			
Moroccan	<b>1.06 (1.02-1.11)</b>	<b>1.06 (1.02-1.10)</b>	1.02 (0.98-1.07)
Turkish	<b>0.95 (0.92-0.98)</b>	0.96 (0.93-0.99)	0.93 (0.89-0.96)
Surinamese	<b>1.25 (1.21-1.29)</b>	<b>1.17 (1.13-1.21)</b>	<b>1.14 (1.10-1.18)</b>
Antillean	<b>1.21 (1.16-1.26)</b>	<b>1.13 (1.08-1.18)</b>	<b>1.10 (1.06-1.15)</b>
Other non-Western groups	<b>1.14 (1.11-1.18)</b>	<b>1.11 (1.08-1.15)</b>	<b>1.09 (1.06-1.12)</b>
<b>Excess LOS in second generation ≤45 years</b>			
Ethnicity (reference: ethnic Dutch patients)			
Moroccan	<b>1.15 (1.10-1.20)</b>	<b>1.10 (1.05-1.15)</b>	<b>1.06 (1.01-1.11)</b>
Turkish	<b>1.10 (1.05-1.15)</b>	<b>1.06 (1.02-1.11)</b>	1.03 (0.98-1.07)
Surinamese	<b>1.05 (1.00-1.10)</b>	0.99 (0.95-1.04)	0.98 (0.94-1.03)
Antillean	0.95 (0.89-1.02)	0.93 (0.87-1.00)	0.93 (0.87-0.99)
Other non-Western groups	<b>1.08 (1.03-1.13)</b>	1.04 (0.99-1.09)	1.03 (0.98-1.08)

a. Excess length of stay (LOS) is defined as a hospital stay that is at least three days longer than the predicted length of hospital stay.

b. Odds ratios that were statistically significant are printed in bold.

Sensitivity analyses with higher absolute threshold values for excess LOS (5 and 7 days) showed the same pattern for all groups, while the ethnic differences slightly increased. Using relative thresholds, 20, 50, 100% excess LOS showed the same pattern as using absolute thresholds. The largest differences were found when using 100% excess LOS, but ORs were still within the confidence intervals of our primary analysis. Statistical significance did not change, with higher thresholds for excess LOS, thus our results are robust.

Subgroup analyses for first- and second-generation patients of  $\leq 45$  years showed that Surinamese, Antillean and other non-Western patients of the first generation have higher ORs for both outcomes than those of the second generation (table 3). The opposite was found for Moroccan and Turkish patients; for both outcomes, the risk was larger for the second generation than for the first.

## DISCUSSION

This study provides the first nationwide estimates of ethnic variations in hospital readmission rates and excess LOS in a European country. The results show that, overall, ethnic minority groups had an increased risk of unplanned readmission within 30 days and excess LOS of at least 3 days during hospitalization. These variations were explained partially, although not substantially, by socio-economic indicators. The excess risks of unplanned readmission and excess LOS were more pronounced in patients >45 years. Comparisons by generation in patients ≤45 years showed contradictory results.

The higher readmission rates among ethnic minority patients did not seem to be attributable to more early discharges, as on average, patients from ethnic minorities also had longer LOS than ethnic Dutch patients. However, because both outcomes could not be combined in the same model, we cannot exclude that differences in unplanned readmissions are partly explained by shorter admissions.

Ethnic differences in excess LOS and readmission rates may reflect appropriately targeted care or an inappropriate suboptimal care process, see figure 1.

Patient characteristics related to health status (need for health care) were taken into account to some extent by adjusting our analyses for diagnosis and co-morbidity. Additional adjustment for socio-economic indicators partially explained ethnic variation in excess LOS and unplanned readmission. Comparison of ethnic groups by generation in patients ≤45 years did not suggest a clear influence of factors such as language problems or cultural distance. The hypothesis of less increased risk of excess LOS and readmission for second compared with first generation was confirmed in Surinamese and Antillean patients, in whom the language barrier is less pronounced. However, in Turkish and Moroccan patients, with relatively large cultural distance and language barriers, we found the opposite. Thus factors other than language and cultural distance may play a role.

Influence of health care characteristics could be analysed in less detail in this study. In a sensitivity analysis, we studied whether ethnic variation showed clustering at a hospital level, which may indicate influence of hospital-service characteristics. We found a weak association. In the USA, poorer quality of hospitals in regions where most ethnic minority patients live was shown.[41,42] Our results do not support this explanation. In addition, a nationwide structured record review study on adverse events in Dutch hospitals found no statistically significant differences in adverse event rates between hospitals. The Dutch health care system does not distinguish between public and private hospitals;[43] there are no typically minority-serving hospitals like in the USA. Both reasons suggest that the quality variations between hospitals are probably much smaller in the Netherlands than in the USA. Therefore, we conclude that our results are not caused by differences between hospitals in quality of care.[18,41,43]

The interaction between patients and health care providers may have led to both appropriate or inappropriate excess LOS and unplanned readmissions (figure 1). A previous qualitative study showed that actual shortfalls in quality of care for ethnic minority patients do occur and may lead to excess LOS and higher readmission rates among minority patients. For

instance, language barriers between physician and patient may incur a higher risk of extra bed days or readmission because of a delayed or wrong diagnosis.[25,26,28,44] However, an appropriate reaction to language barriers may lead to appropriate extra LOS if for instance rehabilitation takes longer because of this. With the data available in this study, we cannot get insight in the interaction between health care provider and patient.

Our findings confirm and extend the results from US studies by demonstrating the presence of ethnic variations in LOS and readmission rates. However, we cannot differentiate conclusively between interpretations of these findings. Both appropriate ethnic targeting of care (because of patient factors including language and culture) and ethnic shortfalls in care may underlie our results.

### ***Limitations and strengths***

Our study has some limitations. The classification of ethnicity was based on country of birth, which is a reliable method for the Netherlands.[31] However, this method does not allow us to identify ethnic groups within a country, which is of particular interest for the Surinamese population, which consists of several sub-populations. For explanatory studies on ethnic disparities, assessment of ethnic identity, degree of acculturation, mastery of the language of the host country and religion may be helpful in disentangling patient-related factors.[32] Because we only used 50 diagnostic codes, the adjustment for disease severity may have been inaccurate. Moreover, within diagnostic groups, disease severity may vary between ethnic groups. Although we used the best data available, disease severity beyond diagnosis was not included.

Because we had a broad sample of hospital admissions and our data had limited detail on the underlying diseases, we were unable to select only unplanned readmissions related to the prior admission. However, most readmissions in the relatively short period of 3 months after prior discharge are related to the prior admission, and this imprecision is the same for all ethnic groups. In addition, the unplanned character of readmissions may have been classified incorrectly. Although this misclassification is probably alike for all ethnic groups, it is unclear whether this bias may have led to overestimation or underestimation of the risk differences. We could not analyse whether ethnic differences in ambulatory care use and patients' self management after discharge partly explain differences we found in unplanned readmissions.

Adjustment for case mix relied heavily on data in the HDR. Information on presence of mental health problems is limited in the HDR. In general, only diagnosed and treated mental health problems are registered as a secondary diagnosis in the HDR. Ethnic minorities, and especially those of the first generation, are more often exposed to mental health problems than ethnic Dutch patients.[4] Adjustment for mental health problems would probably partly explain the differences we found. Although the quality of the coded data has been validated, there may be systematic coding differences between hospitals.[45] These coding differences apply to all patients admitted to a hospital, regardless of their ethnicity. Adjustment for clustering at hospital level also diminishes the effect of hospital-related coding differences on the ethnic differences we found, and did not change our results.



Although we used the largest possible data set, the size of the ethnic groups limited our possibilities for adjusting for patient mix in a more detailed way.

The strengths of our study are the validity of the registers, the linkage methods, the large sample size and the 11-year time frame. This enabled identification of ethnic minority groups and provided a first impression of the mechanisms underlying potential ethnic differences in quality of hospital care. Because we included almost all patients admitted to the hospital, we consider our results robust and representative for the majority of health care delivered in Dutch hospitals. The Dutch health care system, including equal financial access for all inhabitants, is comparable with that of many other countries. Therefore, we expect similar findings in other countries with similar health care systems.

## CONCLUSIONS

We found significant ethnic variation in excess LOS and unplanned readmissions.

The differences found may be interpretable as shortcomings in the quality of hospital care delivered to ethnic minority patients, but with the present data, we cannot exclude alternative explanations such as appropriately targeted care to suit increased need for health care owing to ethnicity-related patient factors.

Future research should measure solid quality outcomes like detailed assessment of health care-related adverse events to establish our supposition of ethnic inequities in quality of care. Mixed methods may provide insight in the interaction between health care providers and patients. Because our results suggest that patient-related factors play an important role, this role needs to be further disentangled in an empirical prospective cohort study among a multi-ethnic hospital population. The ultimate goal is to develop health care that fits the needs of all patients.

## APPENDIX 1. BACKGROUND OF DATABASES USED

### *Hospital discharge register (HDR)*

Since 1986, all general and academic hospitals and most single-specialty hospitals participate in the HDR. For each hospital admission, a record is created in the HDR that includes information on date of birth, sex, numeric part of postal code (since 1991), hospital-specific patient identification code, type of hospital, admission date and principal diagnosis of the admission. The principal diagnosis is determined at discharge and is coded using the ninth revision of the International Classification of Diseases (ICD-9-CM).[46,47]

### *Population register (PR)*

The PR is a dynamic register and comprises information on all registered persons living in the Netherlands. It contains information on date of birth, sex, current address, postal code, nationality, country of origin (both of the registered person and his/her parents) and the date of immigration. The register is longitudinal, and all changes since 1995 are traceable with their period of validity. It is known that for the entire Dutch population, ~85% of the combinations of date of birth, gender and postal code is unique (i.e., occurs only once in the register, and thus identifies one person).[48]

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