Chronic diseases have a huge impact on healthcare systems around the globe. In addition to causing pain, complications and decreased productivity, they affect the patient's family and the whole community. These diseases are the major cause of death all over the world. Of the 57 million global deaths in 2008, 36 million (63%) were due to chronic diseases. Nearly, 80% of chronic disease deaths occur in low and middle-income countries. The incidence and prevalence rates of ESRD are increasing on a yearly basis as shown in Table 1. Around 78% of the total healthcare expenditures in the US are spent on the management of chronic diseases, but still their prevalence is increasing.

What is the level of the quality of care? This is the most frequently asked question by healthcare decision makers, especially if the cost of the management of these diseases is high and they represent a serious threat to life. Of the many chronic diseases, we chose to study end-stage renal disease (ESRD), which is costly and life threatening. Expenditure on ESRD management is a major financial burden on the health system. For instance, it costs 6.3% of the entire Medicare budget in the US and 21% of the total national health insurance budget in Taiwan. The aim of this study was to compare the quality of care of hemodialysis patients in different healthcare sectors in Jeddah using clinical performance measures, which has not previously been done. We suspected that the quality of care was inadequate.

SUBJECTS AND METHODS
This was a cross-sectional study conducted on three different health sectors in Jeddah, Saudi Arabia. During the period of the study (1 Jan 2012 to 31 Dec 2012), there were 1681 hemodialysis patients in Jeddah, who...
represent 14.7% of the total hemodialysis patients of Saudi Arabia. The patients were located in 19 hemodialysis centers in Jeddah run by four different healthcare sectors (35.2% in Ministry Of Health [MOH] sector, 22.8% in governmental (non-MOH) hospitals, 16.6% in charity centers and 25.4% in the private sector). There are two hemodialysis centers in MOH hospitals, 4 centers in governmental (non-MOH) hospitals, 3 charity hemodialysis centers and 10 hemodialysis centers in private hospitals. The majority of hemodialysis patients (74.6%) were receiving healthcare management in the first three sectors,8 because these sectors provide healthcare services free of charge. Therefore, the quality of healthcare in these three sectors is more or less similar and is not affected by the economic status of the patients. Thus, these three sectors were selected to represent the study population. A simple random sampling technique was employed for gathering patient data from all the participating centers, which was done by one of the researchers to avoid selection bias.

For each hemodialysis center, an alphabetical list of all adult hemodialysis patients (18 years old or more) was prepared. Patients were then randomly selected from the list (using random numbers generated by MS Excel 2007). The researchers used the In-Center Hemodialysis (HD) Clinical Performance Measures Data Collection Form 2007 as a data collection tool. This form was used by the Medicare Center in the US to collect data for the Clinical Performance Measures Project.9 This form was generated in 1998 by specialized committees sponsored by the Medicare Center. It was tested at 25 hemodialysis centers in the US and is revised on a yearly basis to ensure its validity and to modify it to comply with any update of the Kidney Disease Outcomes Quality Initiative (KDOQI) guidelines.10 The form is used now by more than 3000 dialysis facilities in the US and has proved quite reliable.9 All the contents of the form can be applied in our society except for the section on variables that are specific to US patients. The race variable was not included because it is not applicable in Saudi Arabia. Medical files of all selected patients were accessed in coordination with the medical record departments in the hemodialysis centers, after which relevant data for the study was collected.

The sample size of 587 hemodialysis patients was calculated using EpiInfo software version 3.5.3. In the calculation, the expected frequencies of the variables under study were set at 50% to get the largest possible sample size; the desired level of precision was set at 5%; the confidence level was 95% and the power was chosen to be 80%. The total number of hemodialysis patients in chosen centers was 1254 and the sample size was calculated for each center separately to ensure that it was representative for each center and could also be used for comparisons between hemodialysis centers.

RESULTS
The characteristics of our study group of 587 patients are shown in Table 2. More than two-thirds of the patients were Saudi (70.7%), and most were males (62.5%). Ages ranged widely in all health sectors, from 18 to 95 years old; the mean (SD) age was 50.8 (16) years.

The most common causes of ESRD in our community were hypertension alone (30.7%) and hypertension with diabetes mellitus (DM) (30.7%), while 15% were idiopathic. DM alone (8.9%) was followed by systemic lupus erythematosus (4.4%) and the least common cause was glomerulonephritis (3.9%). The majority of patients (95.9%) had hemodialysis sessions three times per week and the mean (SD) duration of hemodialysis session was 208.2 (22.2) minutes, whereas the median was 3 hours and a half (210 minutes).

### Table 1. Prevalence and incidence of end-stage renal disease in different countries.

| Country     | Incidence (per million population) | Prevalence (per million population) |
|-------------|------------------------------------|-------------------------------------|
|             | 2006  | 2010  | % change | 2006  | 2010  | % change |
| Saudi Arabia| 120   | 133   | 10.8     | 462   | 498   | 7.8      |
| USA         | 355   | 369   | 3.9      | 1656  | 1870  | 12.9     |
| UK          | 111   | 136   | 22.5     | 723   | 1039  | 43.7     |
| Japan       | 271   | 288   | 6.3      | 1954  | 2260  | 13.5     |

### Table 2. Characteristics of subjects.

| Characteristics | All (n=587) No. (%) | MOH (n=256) No. (%) | Governmental (non MOH) (n=225) No. (%) | Charity (n=106) No. (%) |
|-----------------|---------------------|---------------------|----------------------------------------|-------------------------|
| Nationality     |                     |                     |                                        |                         |
| Saudi           | 415 (70.7%)         | 206 (80.5%)         | 208 (92.4%)                            | 1 (0.9%)                |
| Non Saudi       | 172 (29.3%)         | 50 (19.5%)          | 17 (7.6%)                              | 105 (99.1%)             |
| Gender          |                     |                     |                                        |                         |
| Male            | 367 (62.5%)         | 173 (67.6%)         | 119 (52.9%)                            | 75 (70.8%)              |
| Female          | 220 (37.5%)         | 83 (32.4%)          | 106 (47.1%)                            | 31 (29.2%)              |
| Age in years    |                     |                     |                                        |                         |
| Mean (SD)       | 50.8 (16)           | 46.97 (14.17)       | 57.09 (18.9)                           | 46.7 (13.9)             |
| Median (range)  | 51 (18-95)          | 46.5 (18-82)        | 58 (18-95)                             | 49.5 (18-77)            |
Table 3 shows clinical performance measures for the whole study and for each health sector. The clinical performance measures used in this analysis were based on the KDOQI guidelines. The target level of hemoglobin (Hb) (110-120 g/L) (excluding patients with Hb>120g/L and not prescribed an erythropoietin-stimulating agent) was achieved only in one-fourth of the study groups (25.3%) and this result was almost the same in all health sectors with no statistical significant difference (X²=1.496, df=2 and P=.4733).

A serum ferritin concentration ≥100 µg/L and transferrin saturation ≥20% were documented only in 12.1% of the patients. However, patients in the MOH and charity health sectors achieved this target, whereas in the governmental (non-MOH) health sector only 29.8% of patients achieved this target (X²=100.1, df=2 and P<.001).

Table 3 also shows that about one-fourth (23.5%) of the patients had mean serum level of albumin ≥40 g/L. In the MOH sector, only 5.5% of patients had a mean serum level of albumin ≥40 g/L, whereas in the governmental (non-MOH) sector the percentage reached 48.4%, and only 14.2% in the charity sector. These differences were statistically significant (X²=129.3, df=2, P<.001).

Arteriovenous fistula (AVF) appears to be the

### Table 3. Clinical parameters for hemodialysis patients.

| Serum Level                        | All centers (n=587) No. (%) | MOH (n=256) No. (%) | Gov. Non-MOH (n=225) No. (%) | Charity (n=106) No. (%) | P value<sup>c</sup> | Benchmark to USA Figures (%) |
|------------------------------------|-----------------------------|---------------------|-----------------------------|-------------------------|----------------------|-----------------------------|
| Hb≥110g/L                          | Yes 299 (50.9)              | 114 (44.5)          | 126 (56)                    | 59 (55.7)               | .024                 | 84                          |
|                                   | No 288 (49.1)               | 142 (55.5)          | 99 (44)                     | 47 (44.3)               |                      |                             |
| Hb level (110-120g/L)<sup>a</sup> | Yes 138 (25.3)              | 52 (22.7)           | 60 (27.6)                   | 26 (26.3)               | .4733                | 33                          |
|                                   | No 407 (74.7)               | 177 (77.3)          | 157 (72.4)                  | 73 (73.7)               |                      |                             |
| Ferritin level ≥100 µg/L & Transferrin Saturation ≥20%<sup>b</sup> | Yes 61 (12.1)               | 0 (0)               | 61 (29.6)                   | 0 (0)                   | .001                 | 82                          |
|                                   | No 442 (87.9)               | 200 (100)           | 145 (70.4)                  | 97 (100)                |                      |                             |
| Calcium (2.1-2.38 mmol/L)         | Yes 266 (45.3)              | 94 (36.7)           | 128 (56.9)                  | 44 (41.5)               | .001                 | 83                          |
|                                   | No 218 (54.2)               | 159 (62.1)          | 97 (43.1)                   | 62 (58.5)               |                      |                             |
|                                   | Missing 3 (0.5)             | 3 (1.2)             | 0 (0%)                      | 0 (0%)                  |                      |                             |
| Phosphorus (1.13-1.78 mmol/L)     | Yes 227 (38.7)              | 78 (30.5)           | 111 (49.3)                  | 38 (35.9)               | .001                 | 52                          |
|                                   | No 347 (59.1)               | 167 (65.2)          | 113 (50.2)                  | 67 (63.2)               |                      |                             |
|                                   | Missing 13 (2.2)            | 11 (4.3)            | 1 (0.4)                     | 1 (0.9)                 |                      |                             |
| Albumin ≥40 g/L                   | Yes 138 (23.5)              | 14 (5.5)            | 109 (48.4)                  | 15 (14.2)               | .001                 | 34                          |
|                                   | No 449 (76.5)               | 242 (94.5)          | 116 (51.6)                  | 91 (85.8)               |                      |                             |
| AVF                               | Yes 495 (84.3)              | 238 (93)            | 157 (69.8)                  | 100 (94.3)              | .001                 | 45                          |
|                                   | No 92 (15.7)                | 18 (7)              | 68 (30.2)                   | 6 (5.7)                 |                      |                             |
| Catheter used ≥90 days            | Yes 78 (13.3)               | 13 (5.1)            | 62 (27.6)                   | 3 (2.8)                 | .001                 | 22                          |
|                                   | No 509 (86.7)               | 243 (94.9)          | 163 (72.4)                  | 103 (97.2)              |                      |                             |

AVF: arteriovenous fistula, eSA: erythropoietin-stimulating agent; <sup>a</sup>Excluding patients with Hb> 120g/L and not prescribed eSA (n=545); <sup>b</sup>Excluding patients with Hb ≥ 110g/L and not prescribed eSA (n=503); <sup>c</sup>Chi-square test
most common kind of vascular access used for hemo-
dialysis patients (84%) followed by catheter (15.7%),
(Table 4). Patients using a catheter ≥90 days repre-
sented 13.3% of the study population.

DISCUSSION
The incidence and prevalence of ESRD is rising alarm-
ingly, not only in Saudi Arabia but also around the
glob. In Saudi Arabia, the prevalence of DM and
hypertension are increasing and the risk of ESRD is
increasing day by day. Therefore, studies on the inci-
dence and prevalence of ESRD are important for de-
voping policies to avoid this catastrophic problem among
the population of Saudi Arabia. In the present study the
majority of the patients in all healthcare sectors were
Saudis and were predominately male. Our results are
consistent with the local data published by the Saudi
Center for Organ Transplantation (SCOT) in 2010
taking into consideration that this study involves only
adult hemodialysis patients. Moreover, it is also com-
patible with data published by ERA-EDTA Registry
Annual Report (2012).

Our results show a wide age range of patients from
18 to 95 years and the mean (SD) age of patients was
50.8 (16) years. This wide age range indicates that
ESRD may occur at any age and is comparable with
the Report of the SCOT in 2010. In our study, hyper-
tension and diabetes mellitus were the major causes of
ESRD, followed by an idiopathic etiology. This result
is in agreement with the data published by SCOT in
its Annual Report in 2010. Our study shows that only
(50.94%) of patients have Hb ≥110 g/L, which means
that almost half of the patients were anemic. In the US,
most patients have Hb ≥110g/L (84%).

On the clinical performance measure of anemia, the
percentage of patients with an hemoglobin level between
110 and 120 g/L (excluding patients with Hb>120 g/L
and not prescribed an erythropoiesis-stimulating agent)
was only 25.3% and not statistically different among dif-
ferent health sectors. This figure was less than that re-
corded in Iran in 2008, which indicated that half of the patients
had attained the normal hemoglobin target. In addition,
this figure was 33% in the US.

Among anemic patients or patients prescribed an
erythropoiesis-stimulating agent with at least one docu-
menced ferritin ≥100 µg/L and transferrin saturation
≥20% during the study period), only 29.8% of patients
in the governmental (non-MOH) sector achieved this
target. In our whole study population only 12.1% pa-
tients achieved this target. Our results show fewer pa-
tients compared with a US study that reported that
82% of patients achieved this target.

In the management of mineral metabolism, only
45.3% of patients attained the targeted calcium level.
Furthermore, it was found that there was significant variation (P<.001) among the three health sectors:
the governmental (non-MOH) sector exhibited the highest score (49.3%) followed by charity centers and
the MOH sector. These results differ from a US study
that reported 83% of patients achieved the target level
of calcium. We found that only 38.7% of the patients
attained the targeted level of phosphorous while a study in the US documented 52% of the patients.
The inadequacy of anemia and mineral metabolism
management can be related to a lack of written proto-
cols and less availability of laboratory tests as shown
in many studies conducted in Saudi Arabia.

In our study, 84% of patients used AVF and 15.7%
of patients used a catheter during their last hemo-
dialysis session. These figures achieve the target of
KDOQI guidelines for vascular access management,
which recommend that AVF should be the primary
access for at least 40% of patients undergoing hemo-
dialysis. In comparison to the US, this figure is higher
than in the American proportion (45%). In our study,
13.3% of patients dialyzed using a catheter for ≥90
days which is near the target in the KDOQI guide-
lines (≤10%). This figure is also better than the US
(22%). Vascular access management was consistent
with local figures published by SCOT. The qual-
ity of the care in all healthcare sectors (MOH, non-
governmental MOH and charity) is not up to mark.
The levels for most parameters are below the normal
range, which needs serious attention and action from
the concerned authorities. This would help to improve
the care provided for several patients and help in sav-
ing their precious lives.

CONCLUSION
Our results indicate that in all three healthcare sectors
the majority of patients did not reach the targeted lev-
els for several parameters. The quality of healthcare for

| Types of Vascular Access | All Sectors (n=587) | MOH (n=256) | Gov. Non-MOH (n=225) | Charity (n=106) |
|-------------------------|-------------------|------------|---------------------|---------------|
| AVF                     | 495 (84.3)        | 238 (93)   | 157 (69.8)          | 100 (94.3)    |
| Catheter                | 92 (15.7)         | 18 (7)     | 68 (30.2)           | 6 (5.7)       |
| Catheter Used ≥ 90 Days | 76 (13.3)         | 13 (5.1)   | 62 (27.6)           | 3 (2.8)       |

AVF should be > 80%; Catheter Used ≥ 90 Days not > 10%.
hemodialysis patients in Jeddah needs improvements to achieve the targeted levels of hemoglobin, calcium, phosphorous and other parameters and to match the recommendations of the KDOQI guidelines. More research is needed to reveal the effect of achieving the targets of these parameters on morbidity, mortality, and quality of life and the cost of the management. A similar annual nationwide study will greatly benefit all hemodialysis centers in comparing their performance with national and regional figures.

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