Background: Continuity of care (COC) has received attention over the past decade. COC has also become increasingly important for hospital managers and policy makers because of competitive health care market conditions. The purpose of this study was to assess the association between hospital charges and patients’ continuity of care—assessed by three indices of continuity of care—among outpatients with hypertension in South Korea.

Methods: This study used the National Health Insurance Service–Cohort Sample Database from 2002 to 2013. A total of 247,125 participants were analyzed at baseline (2002); continuity of care was defined using the continuity of care index, the Herfindahl–Hirschman index (a new continuity of care index), and the “most frequent provider continuity” index. Primary analyses were based on the generalized estimating equation regression model, which accounts for correlation among individuals within each hospital.

Results: After adjustment for age, sex, residential region, patient clinical complexity level, diagnosed code, hospital type, organization type, number of beds, number of doctors, and year, there was a negative correlation between hospital charges and continuity of care index ($\beta=-0.163, P<0.0001$), the Herfindahl–Hirschman index ($\beta=-0.105, P<0.0001$), and the “most frequent provider continuity” index ($\beta=-0.131, P<0.0001$). Subgroup analyses based on hospital type produced similar trends.

Conclusion: For all indices studied, hospital charges declined gradually with increasing continuity of care. Our study suggests that long-term, trusting partnerships between patients and physicians reduce hospital costs.

Keywords: Hospitals; Continuity of Patient Care
INTRODUCTION

Continuity of care (COC) has received attention over the past decade. Defined as a sustained partnership between patient and physician, COC is considered a core element reflecting high-quality care and patient satisfaction. It contributes to improved patient adherence and self-management, improved health outcomes, and lower healthcare utilization and costs. It is assumed that patients who maintain COC relationships with their physicians care more about their health than those who do not maintain such relationships.

COC encourages strong physician-patient affiliation, trust, and communication, with the physician accumulating knowledge of the patient's history and values. It also instills in the patient a sense of clinical self-responsibility, allowing physicians to provide better care at a lower cost. COC has also become increasingly important for hospital managers and policy makers, because the healthcare industry in South Korea is becoming more competitive. As patients can now choose from a wide range of providers, many hospitals have been forced to compete with each other for a larger share of the market, regardless of the size of the hospital. It is becoming vital to the long-term financial performance of hospitals in competitive markets to sustain relationships between physicians and patients by providing high-quality care. If physicians do not meet the needs of patients effectively and efficiently, providers will be at risk of losing market share, and their viability will be threatened.

Many studies have found that those with higher COC use fewer resources and have lower healthcare costs. Furthermore, the association is stronger in the case of inpatients than in that of outpatients, suggesting that the main benefit of COC is that it reduces emergency department visits and hospitalizations. Thus, to ensure their long-term success and survival, it is important that hospitals retain and expand their regular patient base through high COC. Moreover, Zeithaml et al. suggested that when patients assess positively service quality, it leads to desirable behavioral intentions, further strengthening their relationship with the physician. In the competitive healthcare market of South Korea, measuring each patient's COC within the hospital as a major source of competitive advantage is an important business strategy.

This study examined the association between COC and hospital charges among outpatients with hypertension in hospitals in South Korea. Hypertension is an important independent risk factor for cardiovascular events, which are a major cause of death. Furthermore, patients with hypertension tend to visit healthcare institutions on a regular basis to receive prescriptions and education for blood pressure management, making them ideal subjects to observe the patient-physician relationship.

METHODS

1. Data Sources and Study Design

This study used the National Health Insurance Service–Cohort Sample Database (NHIS-CSD) from 2002 to 2013, which has been released by the Korean National Health Insurance Service (KNHIS). The initial NHIS-CSD cohort (n=1,025,340—approximately 2.2% of the entire population in 2002) was established by stratified random sampling using a systematic sampling method to generate a representative sample of the 46,605,433 South Korean residents recorded in 2002. We excluded non-citizens and special-purpose employees with an unidentifiable income level. The baseline cohort members were followed for 11 years until 2013, unless they were disqualified due to death or emigration. The healthcare utilization claims include information on prescription drugs, medical procedures, diagnostic codes based on the International Classification of Diseases, tenth revision (ICD-10), and healthcare costs. Detailed methods for establishing and ensuring the representativeness of the NHIS-CSD cohort have been published on the KNHIS website.

To analyze the relationship between COC and hospital charges among outpatients with hypertension, we isolated outpatients with the ICD-10 codes I10–I15 (hypertensive diseases) as their main diagnosis. We then linked each outpatient with hypertension to a particular hospital using a separate hospital licensing database that contains information arranged by calendar years. This linkage between outpatients and hospitals allowed us to investigate our hypothesis in a 12-year follow-up.

2. Study Variables: Independent Variables

1) Continuity of care index

The COC index emphasizes the distribution of visits to each hospital that the patient visited. One of the advantages of the COC index is that it reflects the co-ordination of care that occurs when one provider refers a patient to another provider and then receives the patient’s referral again. The COC index measures the concentration or diversity of visits among all providers. Interestingly, for a given visit distribution, the COC index tends to increase as the total number of visits increases. However, the index is not affected by the sequencing of visits.

\[
\sum_{j=1}^{M} n_j^2 - N) / N(N - 1)
\]

N=total number of outpatient visits
n_j=number of visits to provider j

2) Herfindahl–Hirschman index

The Herfindahl–Hirschman index (HHI—a new COC) was initially proposed by Zwanziger et al. to measure market concentration using the sum of the squares of discharges from a disease category, viewed as a proportion of all discharges from the hospital. The present study measured the concentration of each patient per hospital. To investigate each patient’s COC, we considered that having a narrower mix tends to cause an increase in the patient’s COC in the hospital visited.
HHI (New COC) = \sum_{i=1}^{n} \left( P_i \right)^2

\quad P_i = \text{proportion of the number of each hospital visits accounted for by the } i\text{th hospital}

3) Most frequent provider continuity index

The “most frequent provider continuity” (MFPC) index primarily measures the concentration of visits in the hospital most often seen. Its value is not affected by the distribution of visits to other providers, or by the sequence in which visits are made to different providers. The MFPC index is constant, because the proportion of visits to the most frequent provider does not change as the number of visits increases. In contrast, the HHI focuses on the concentration of visits across all hospitals, while the COC index integrates both aspects into a single metric. In terms of measurement method, the MFPC index is a similar concept to the HHI; however, it only focuses on the density of care from

| Table 1. General characteristics of subjects included for analysis at baseline (2002) |
|---------------------------------|-----------------|-----------------|-----------------|
| Characteristic                  | Total (Number%) | Hospital charges (KRW*) | P-value |
|---------------------------------|-----------------|-----------------|-----------------|
| Individual                      |                 |                 |                 |
| Sex                             |                 |                 |                 |
| Male                            | 98,134 (39.7)   | 17,822±43,988   | 0.795           |
| Female                          | 148,991 (60.3)  | 17,255±32,457   |                 |
| Age (y)                         |                 |                 | <0.0001         |
| ≤39                             | 8,922 (3.6)     | 23,396±84,760   |                 |
| 40–49                           | 38,780 (15.7)   | 16,748±40,645   |                 |
| 50–59                           | 67,844 (27.5)   | 16,475±37,555   |                 |
| 60–69                           | 80,610 (32.6)   | 17,436±33,797   |                 |
| 70–79                           | 24,980 (10.1)   | 18,642±27,753   |                 |
| ≥80                             | 25,899 (10.5)   | 18,182±20,808   |                 |
| Residential region              |                 |                 | <0.0001         |
| Metropolitan                    | 54,390 (22.0)   | 17,235±32,936   |                 |
| Urban                           | 67,002 (27.1)   | 17,821±41,391   |                 |
| Rural                           | 125,733 (50.9)  | 17,404±37,100   |                 |
| Patient clinical complexity level|                 |                 |                 |
| 0                               | 247,125 (100.0) | 17,480±37,464   | <0.0001         |
| 1                               |                 |                 |                 |
| ≥2                              |                 |                 |                 |
| Diagnosed code (I10–I15)        |                 |                 | <0.0001         |
| Essential hypertension           | 211,157 (85.5)  | 16,562±19,606   |                 |
| Hypertensive heart disease       | 27,238 (11.0)   | 17,100±19,963   |                 |
| Hypertensive renal disease       | 1,842 (0.8)     | 116,053±350,229 |                 |
| Hypertensive heart and renal disease | 4,727 (1.9) | 19,321±22,229   |                 |
| Secondary hypertension           | 2,161 (0.9)     | 23,895±62,722   |                 |
| Hospital                         |                 |                 | <0.0001         |
| Type                            |                 |                 |                 |
| General hospital                 | 31,176 (12.6)   | 29,969±94,264   |                 |
| Hospital                        | 4,991 (2.0)     | 22,389±61,009   |                 |
| Clinic                          | 210,958 (85.4)  | 15,518±14,681   |                 |
| Organization type               |                 |                 | 0.334           |
| Public                          | 924 (0.4)       | 21,940±28,839   |                 |
| Private                         | 246,201 (99.6)  | 17,463±37,492   |                 |
| Bed                             |                 |                 | <0.0001         |
| ≤99                             | 212,951 (86.2)  | 15,572±16,879   |                 |
| 100–199                         | 2,379 (1.0)     | 22,571±30,838   |                 |
| 200–299                         | 2,085 (0.8)     | 20,761±29,952   |                 |
| ≥300                            | 29,710 (12.0)   | 30,518±96,411   |                 |
| Doctor                          |                 |                 | <0.0001         |
| ≤49                             | 220,929 (89.4)  | 15,924±17,947   |                 |
| 50–99                           | 2,128 (0.9)     | 23,050±41,079   |                 |
| 100–149                         | 5,470 (2.2)     | 21,449±34,683   |                 |
| ≥150                            | 18,598 (7.5)    | 34,156±118,165  |                 |
| Total                           | 247,125 (100.0) | 17,480±37,464   |                 |

Values are presented as number (%) or mean±standard deviation.

*1 United States dollar=approximately 1,200 Korean won.
the usual provider, neglecting the remaining providers. In addition, the HHI is generally used to study market structure and measuring market concentration, because it measures COC more easily than the other COC indices.

$$\frac{\max(n_1, n_2, ..., n_M)}{N}$$

where Yit is the hospital charges during a time period t for unit i.

| Variable   | COC          | New COC       | MFPC         |
|------------|--------------|---------------|--------------|
|            | Mean±SD      | r             | Mean±SD      | r           | P-value | Mean±SD      | r             | P-value |
| COC indices| 0.848±0.278  | 0.699         | 0.906±0.180  | <0.0001     | 0.7      | 0.930±0.144  | 0.984         | <0.0001 |
| COC        | 1            | 0.699         | <0.0001     | 0.7         | <0.0001 |
| New COC    | 1            | 0.984         | <0.0001     | 1           |
| MFPC       | 1            |               |             |             |

Correlation coefficient (Cronbach’s α=0.921). COC, continuity of care; MFPC, most frequent provider continuity.
Table 3. Adjusted association between COC and hospital charges

| Variable                                | COC          | New COC        | MFPC         |
|-----------------------------------------|--------------|----------------|--------------|
|                                          | B  SE P-value| B  SE P-value | B  SE P-value|
| Main interesting variable               | -0.163 0.002 <0.0001 | -0.105 0.003 <0.0001 | -0.131 0.003 <0.0001 |
| Individual                              |              |                |              |
| Sex                                     |              |                |              |
| Male                                    | -0.007 0.001 <0.0001 | -0.007 0.001 <0.0001 | -0.007 0.001 <0.0001 |
| Female                                  | Ref          | Ref            | Ref          |
| Age (y)                                 |              |                |              |
| ≤39                                     | 0.051 0.004 <0.0001 | 0.057 0.004 <0.0001 | 0.057 0.004 <0.0001 |
| 40–49                                   | 0.000 0.003 0.966 | -0.001 0.003 0.779 | -0.001 0.003 0.745 |
| 50–59                                   | 0.001 0.002 0.640 | -0.001 0.002 0.705 | -0.001 0.002 0.664 |
| 60–69                                   | 0.018 0.003 <0.0001 | 0.016 0.003 <0.0001 | 0.016 0.003 <0.0001 |
| 70–79                                   | 0.030 0.003 <0.0001 | 0.028 0.003 <0.0001 | 0.028 0.003 <0.0001 |
| ≥80                                     | Ref          | Ref            | Ref          |
| Residential region                      |              |                |              |
| Metropolitan                            | -0.011 0.002 <0.0001 | -0.011 0.002 <0.0001 | -0.011 0.002 <0.0001 |
| Urban                                   | -0.006 0.002 0.001 | -0.007 0.002 <0.0001 | -0.007 0.002 <0.0001 |
| Rural                                   | Ref          | Ref            | Ref          |
| Patient clinical complexity level        |              |                |              |
| 0                                       | -0.157 0.003 <0.0001 | -0.155 0.003 <0.0001 | -0.155 0.003 <0.0001 |
| 1                                       | -0.041 0.004 <0.0001 | -0.041 0.004 <0.0001 | -0.040 0.004 <0.0001 |
| ≥2                                      | Ref          | Ref            | Ref          |
| Diagnosed code (I10–I15)                |              |                |              |
| Essential hypertension                  | -0.055 0.013 <0.0001 | -0.058 0.013 <0.0001 | -0.058 0.013 <0.0001 |
| Hypertensive heart disease              | -0.046 0.013 0.002 | -0.050 0.013 0.002 | -0.050 0.013 0.013 |
| Hypertensive renal disease              | 0.459 0.041 <0.0001 | 0.454 0.041 <0.0001 | 0.454 0.041 <0.0001 |
| Hypertensive heart and renal disease    | 0.028 0.014 0.049 | 0.024 0.014 0.091 | 0.024 0.014 0.092 |
| Secondary hypertension                  | Ref          | Ref            | Ref          |
| Hospital                                |              |                |              |
| Type                                    |              |                |              |
| General hospital                        | 0.145 0.012 <0.0001 | 0.151 0.012 <0.0001 | 0.151 0.012 <0.0001 |
| Hospital                                | 0.080 0.006 <0.0001 | 0.086 0.006 <0.0001 | 0.086 0.006 <0.0001 |
| Clinic                                  | Ref          | Ref            | Ref          |
| Organization type                       |              |                |              |
| Public                                  | 0.072 0.015 <0.0001 | 0.070 0.015 <0.0001 | 0.070 0.015 <0.0001 |
| Private                                 | Ref          | Ref            | Ref          |
| Bed                                     |              |                |              |
| ≤99                                     | -0.095 0.012 <0.0001 | -0.097 0.012 <0.0001 | -0.097 0.012 <0.0001 |
| 100–199                                 | -0.034 0.011 0.002 | -0.035 0.011 0.002 | -0.035 0.011 0.011 |
| 200–299                                 | -0.029 0.011 0.007 | -0.029 0.011 0.007 | -0.029 0.011 0.007 |
| ≥300                                    | Ref          | Ref            | Ref          |
| Doctor                                  |              |                |              |
| ≤49                                     | -0.189 0.009 <0.0001 | -0.191 0.009 <0.0001 | -0.191 0.009 <0.0001 |
| 50–99                                   | -0.086 0.012 <0.0001 | -0.088 0.012 <0.0001 | -0.088 0.012 <0.0001 |
| 100–149                                 | -0.138 0.010 <0.0001 | -0.140 0.010 <0.0001 | -0.140 0.010 <0.0001 |
| ≥150                                    | Ref          | Ref            | Ref          |
| Year                                    |              |                |              |
| 2002                                    | 0.038 0.003 <0.0001 | 0.045 0.003 <0.0001 | 0.045 0.003 <0.0001 |
| 2003                                    | -0.015 0.003 0.008 | -0.008 0.003 0.001 | -0.008 0.003 0.002 |
| 2004                                    | -0.008 0.003 0.003 | -0.003 0.003 0.321 | -0.002 0.003 0.347 |
| 2005                                    | 0.022 0.002 <0.0001 | 0.026 0.002 <0.0001 | 0.027 0.002 <0.0001 |
| 2006                                    | 0.016 0.002 <0.0001 | 0.020 0.002 <0.0001 | 0.020 0.002 <0.0001 |
| 2007                                    | -0.065 0.002 <0.0001 | -0.062 0.002 <0.0001 | -0.062 0.002 <0.0001 |
| 2008                                    | -0.102 0.002 <0.0001 | -0.100 0.002 <0.0001 | -0.099 0.002 <0.0001 |
| 2009                                    | -0.082 0.002 <0.0001 | -0.080 0.002 <0.0001 | -0.080 0.002 <0.0001 |
| 2010                                    | -0.059 0.002 <0.0001 | -0.058 0.002 <0.0001 | -0.058 0.002 <0.0001 |
| 2011                                    | -0.033 0.002 <0.0001 | -0.031 0.002 <0.0001 | -0.031 0.002 <0.0001 |
| 2012                                    | -0.035 0.002 <0.0001 | -0.034 0.002 <0.0001 | -0.034 0.002 <0.0001 |
| 2013                                    | Ref          | Ref            | Ref          |

COC, continuity of care; MFPC, most frequent provider continuity; SE, standard error; Ref, reference.
The present study revealed that all COC indices, including the COC index, HHI, and MFPC index, are significantly associated with hospital charges among outpatients with hypertensive diseases. The results provide concrete evidence—based on all the continuity indices—that outpatients with higher COC (strong relationship with hospital or physician) have lower hospital charges, even after controlling for potential confounders, including PCCL—an indicator of severity. Given that hospital charges depend on hospital type, we conducted a subgroup analysis according to hospital type. The analysis showed that, for each index, the direction and significance of the association were the same. That is, the negative association between hospital charges and COC was significant in both hospitals and clinics, regardless of which index was used. Hospitals tend to have more expensive equipment than clinics, and they use a larger variety of assessment tools. Visiting such hospitals consecutively would be costly; this would in turn have an effect on hospital charges. Contrarily, clinics use less expensive assessment tools and examinations to treat patients, meaning a smaller baseline cost and a smaller reduction in clinic charge compared with hospitals.

According to the planned behavior theory, behavioral intentions affect future behaviors. Desirable behavioral intentions result in a loyal customer who has “a deeply held commitment to rebuying or re-patronizing health services consistently in the future” probably because of greater trust and higher satisfaction with their physicians. In addition, willingness to go back to the same hospital is affected by cost, service quality, patient satisfaction, perceived value, assurance, and reliability and empathy of the hospitals. Several pieces of evidence have shown that the price of healthcare is a major deterrent to many people who would like to visit hospitals.

Patients with lack of COC are more likely to visit another hospital and switch doctors. Safran et al. researched a group of elderly Americans who had received 10 or more years of continuous care and concluded that annual costs in this group were over $300 less than in comparable patients who had received 1 year or less with a usual provider of care. Another study found that patients who had continuity with the same hospital had lower resource utilization and healthcare costs. A better understanding of patients will enable policy makers and hospital managers to develop appropriate marketing strategies, attracting new patients and retaining existing customers. Therefore, increasing the perceived value of hospitals by enhancing COC may contribute hospitals’ long-term sustainability.

DISCUSSION

In conclusion, we measured COC index to reflect patients’ COC over 12 years; we also analyzed the relationship between COC and hospital charges among patients with hypertension. Reduced hospital charges were associated with COC. Our study provides empirical evidence that increasing patient COC adds value to the management of chronic conditions, suggesting that long-term and trusting patient-physician relationships are important in reducing healthcare costs.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

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