

# Comparative Survey on Nutrition Risk and Nutrition Support Among Hospitalized General Surgery Patients Over a 7-Year Period

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## Abstract

**Background:** In China, the trend of the prevalence of nutrition risk and malnutrition among the patients in hospitals has changed dramatically in the past few years. The aim of this study was to compare the prevalence of nutrition risk, undernutrition, and the application of nutrition support among hospitalized general surgery patients over a 7-year period from 2010 to 2017. **Methods:** A total of 810 consecutive inpatients who met the inclusion criteria upon admission and provided informed consent were recruited from March to December 2017. Nutrition risk was screened using the Nutritional Risk Screening 2002 tool. All the data collected in 2017 were compared with the data collected in 2010. **Results:** The prevalence of undernutrition among the surgical patients in 2017 (12.8%) was lower than that in 2011 (15.5%) ( $P < .05$ ), whereas the prevalence of nutrition risk in 2017 (42.6%) was higher than that in 2011 (30.4%) ( $P < .01$ ). The application of nutrition support, including parenteral nutrition and enteral nutrition, among the patients in 2017 was higher than that in 2010 ( $P < .05$ ). In 2017, 70.7% of the patients who were at nutrition risk received nutrition support, whereas only 48.9% of patients at nutrition risk did in 2010 ( $P < .05$ ). Moreover, 26.9% of patients without nutrition risk received nutrition support in 2017 compared with 18.0% of patients in 2010. **Conclusions:** The nutrition statuses among surgical inpatients changed from 2010 to 2017. The prevalence of undernutrition was reduced, whereas the prevalence of nutrition risk increased. The application of nutrition support increased significantly, whereas inappropriate application of nutrition support still existed in our hospital. More attention should be paid to the nutrition-related issues of general surgery inpatients in the future. (*JPEN J Parenter Enteral Nutr.* 2020;44:1468–1474)

## Keywords

general surgical inpatients; Nutritional Risk Screening 2002; nutrition support; undernutrition

## Clinical Relevancy Statement

The status of undernutrition, which is very common among hospitalized patients and often leads to deterioration of the state of an illness, has gradually become a key concern among clinicians, especially surgeons. In China, the trend of the prevalence of nutrition risk and malnutrition among

the patients in hospitals has changed in the last 20 years. The purpose of this study was to compare the prevalence of nutrition risk, undernutrition, and the application of nutrition support among hospitalized general surgery patients in the same hospital from 2010 to 2017 over a 7-year period to provide evidence for implementing appropriate nutrition interventions among the hospitalized surgery patients.

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## Introduction

In the past 2 decades, the prevalence rate of malnutrition and nutrition risk varied from 10% to 50% among hospitalized patients throughout the world.<sup>1-3</sup> Malnutrition, in terms of undernutrition, is known to be associated with a number of adverse clinical outcomes in hospitalized patients, including decreased wound healing, higher rate of infections, prolonged length of hospital stay, increased readmission rate, and dissatisfactory response to clinical medical treatment.<sup>4-7</sup> To address the above issue, appropriate nutrition support is essential. However, only patients in the status of undernutrition or at nutrition risk should receive nutrition support and could benefit from nutrition therapy according to the guidelines.<sup>8,9</sup> Therefore, accurate nutrition screening is important for distinguishing patients with early nutrition risk and implementing further appropriate nutrition interventions. Currently, several nutrition screening tools can be used.<sup>10-12</sup> The Malnutrition Universal Screening Tool (MUST) is recommended by the European Society for Clinical Nutrition and Metabolism (ESPEN) for adults in community settings, whereas the Mini Nutritional Assessment (MNA) is identified as suitable for the elderly.<sup>11</sup> The Nutritional Risk Screening 2002 (NRS-2002), based on 128 randomized controlled clinical trials, is recommended by ESPEN for nutrition screening among hospitalized patients.<sup>10</sup> In China, the feasibility of NRS-2002 was tested by a series of studies among hospitalized patients, which indicated that this tool can be applied among Chinese inpatients for nutrition risk screening.<sup>2,13-15</sup> Thus, NRS-2002 is recommended by the Society of Parenteral and Enteral Nutrition of the Chinese Medical Association for nutrition screening for hospitalized patients in China.

In China, the prevalence of undernutrition and nutrition risk among inpatients has been reported to range from 20% to 40% and 10% to 20%, respectively, over the last 20 years.<sup>2,7,14-18</sup> For surgical patients, undernutrition, which is very common and often leads to the deterioration of the state of an illness, has gradually become a key concern for surgeons.<sup>2,15,17</sup> Therefore, identifying the surgery patients with undernutrition or nutrition risk as soon as possible may help to avoid the risk of poor clinical outcomes.

To address the above issue, as early as 2010, our previous research reported that the prevalence of undernutrition and nutrition risk among surgery patients was 15.5% and 30.4%, respectively, in Sichuan Province of Southwest China.<sup>19</sup> Based on previous research, the aim of this study was to investigate the prevalence of nutrition risk, undernutrition, and the application of nutrition support among surgical patients in the same hospital to evaluate changes in nutrition status over a 7-year period from 2010 to 2017. The findings from this study may provide evidence for implementing appropriate nutrition interventions among hospitalized surgical patients.

## Methods

### *Study Sample*

The surgical patients admitted to the departments of hepato-pancreato-biliary surgery, gastrointestinal surgery, and thyroid vascular surgery of Sichuan Provincial People's Hospital from March to December 2017 were recruited using continuous fixed-point sampling as the sampling method in 2010 and were followed up until discharge. The inclusion criteria for patients to be invited to participate included the following: (1) age 18–90 years; (2) scheduled to stay at least 5 days in the hospital; (3) not subjected to emergency surgery within 24 hours after admission; (4) well oriented to time and place; and (5) having a conscious mind. Participants and their relatives were informed about the study and provided written informed consent. The patients' privacy was protected in this study. The study protocol was approved by the Ethics Committee of Sichuan Provincial People's Hospital.

*Medical history and dietary data.* All of the following information was collected: basic information, hospitalization indication, complications, main diagnosis, previous normal weight, weight loss within the last 1–3 months, normal dietary intake requirements, dietary intake in the last week, and neuropsychiatric problems.

*Anthropometry.* The weights and standing heights of the patients were measured before meals on the first morning after admission by trained investigators according to standard procedures. Patients were dressed in a hospital gown and were barefoot. Standing height was measured to the nearest 0.5 cm, and body weight was measured to the nearest 0.1 kg.

### *Nutrition Risk Screening*

Nutrition risk screening was carried out within the first 24 hours after admission using the NRS-2002. There are 4 key components of the NRS-2002 in the initial screening: body mass index (BMI), weight loss, food intake, and severity of disease. The information (including weight loss and food intake) was carefully collected by well-trained investigators using a questionnaire. In the final screening, the total score was calculated by adding the nutrition status score (0–3) to the severity of disease score (0–3), plus a score of 1 for patients  $\geq 70$  years of age. Patients with an NRS-2002  $\geq 3$  were considered at nutrition risk requiring nutrition support, whereas an NRS-2002  $< 3$  indicated no nutrition risk.

### *Nutrition Status Assessment*

In this analysis, BMI was calculated as weight/height<sup>2</sup> (kg/m<sup>2</sup>). BMI was used to classify undernutrition, over-

weight, and obesity. According to the ESPEN consensus statement, the diagnostic criterion for undernutrition is defined by a BMI < 18.5 kg/m<sup>2</sup> or the combined finding of unintentional weight loss (either >10% of habitual weight indefinite of time or >5% over 3 months) and reduced BMI (BMI < 20 or <22 kg/m<sup>2</sup> in participants younger and older than 70 years, respectively).<sup>20</sup>

### Definition of Nutrition Support

In this study, nutrition support data from patients were collected 2 weeks after admission or until discharge and included parenteral nutrition (PN) and enteral nutrition (EN). PN is defined as a combination of 2 or more nutrients, including glucose, amino acids, and lipids, via peripheral or central veins when a nonprotein daily energy intake  $\geq$  10 kcal/kg/d can be maintained for  $\geq$  5 days. EN is defined as the use of an oral nutrition supplement or tube feeding when a daily energy intake  $\geq$  10 kcal/kg/d can be maintained for  $\geq$  5 days.<sup>21</sup>

All the data were compared with the data collected in 2010 to evaluate the changes in nutrition status over a 7-year period.

### Statistical Analysis

In this study, EPI Data 3.1 was used for data entry. Statistical analyses were carried out using Statistical Analyses System (SAS, version 9.1). A *P*-value < .05 was considered statistically significant. Descriptive data are presented as the means  $\pm$  SDs or percentages—for example, the percentage of patients classified as at nutrition risk or not or suffering from undernutrition and the percentage of patients receiving EN or PN. Differences in characteristics of the patients in between 2017 and 2010 were tested using *t*-tests for normally distributed continuous variables and Wilcoxon rank sum tests for nonnormally distributed continuous variables. A  $\chi^2$  test was used to compare the nutrition risk rate and nutrition support rate among the patients between 2017 and 2010.

## Results

### Demographic Data

A total of 1021 general surgery patients in Sichuan Provincial People's Hospital were recruited in 2017. Among them, 45 patients declined to participate in the study, resulting in a response rate of 96%. Furthermore, 112 patients were excluded for implausible nutrition risk screening information (including 79 patients missing weight data), and 54 were also excluded for missing nutrition support (EN or PN) data. In total, 810 patients (males = 431, females = 379) were finally included in our analysis, including 320 patients from the department of hepato-pancreato-biliary surgery, 306 patients

**Table 1.** Characteristics of the Surgery Patients in 2017 and 2010.<sup>a</sup>

Characteristic	Patients in 2010	Patients in 2017 <sup>b</sup>
n	625	810
Age, y	54.28 $\pm$ 13.13	56.31 $\pm$ 15.75
Male, n (%)	348 (55.7)	431 (53.2)
BMI, kg/m <sup>2</sup>	21.0 $\pm$ 5.6	23.4 $\pm$ 7.4
Patients $\geq$ 65 y, n (%) <sup>c</sup>	202 (32.3)	275 (33.9)
Hepato-pancreato-biliary surgery, n (%) <sup>d</sup>	254 (40.6)	320 (39.5)
Gastrointestinal surgery, n (%) <sup>e</sup>	241 (38.6)	306 (37.8)
Thyroid vascular surgery, n (%) <sup>f</sup>	130 (20.8)	184 (22.7)

BMI, body mass index.

<sup>a</sup> Values are means  $\pm$  SDs or frequencies.

<sup>b</sup> Tests for differences between the patients in 2017 and 2010 were performed using *t*-tests for normally distributed continuous variables, Wilcoxon rank sum tests were used for nonnormally distributed continuous variables, and  $\chi^2$  tests were used for categorical variables.

<sup>c</sup> n, the number of patients with age  $\geq$  65 years; %, in terms of percentage.

<sup>d</sup> n, the number of patients from the department of hepato-pancreato-biliary surgery; %, in terms of percentage.

<sup>e</sup> n, the number of patients from the department of gastrointestinal surgery; %, in terms of percentage.

<sup>f</sup> n, the number of patients from the department of thyroid vascular surgery; %, in terms of percentage.

from the department of gastrointestinal surgery, and 184 patients from the department of thyroid vascular surgery.

The mean BMI  $\pm$  SD of the patients was 23.4  $\pm$  7.4 kg/m<sup>2</sup>. A total of 275 (33.9%) patients were aged  $\geq$  65 years. The mean age was 56.31  $\pm$  15.75 years in 2017. There were no significant differences in the baseline characteristics of the surgical patients between 2017 and 2010 (Table 1).

### Change in the Prevalence of Undernutrition and Nutrition Risk

Of all 810 hospitalized surgery patients in 2017, 104 patients (12.8%) were diagnosed with undernutrition, and 345 patients (42.6%) were at nutrition risk according to nutrition risk screening (NRS-2002). The highest rates of undernutrition (14.7%) and nutrition risk (58.8%) were found in the department of gastrointestinal surgery. The prevalence of undernutrition and nutrition risk by department is detailed in Table 2.

Statistics showed that the prevalence of undernutrition among the patients was lower in 2017 than in 2010 ( $\chi^2 = 6.5$ , *P* < .05), whereas the prevalence of nutrition risk among the patients was higher in 2017 than in 2010 ( $\chi^2 = 20.8$ , *P* < .01) (Table 2).

**Table 2.** Comparison of the Prevalence Rates of Undernutrition and Nutrition Risk Among Surgical Patients in 2017 and 2010.<sup>a</sup>

Departments	Patients in 2010 (n, %) <sup>b</sup>			Patients in 2017 (n, %) <sup>b</sup>		
	n	Undernutrition	Nutrition Risk	n	Undernutrition	Nutrition Risk
Hepato-pancreato-biliary surgery	254	35 (13.8)	72 (28.3)	320	45 (14.1)	128 (40.0) <sup>c</sup>
Gastrointestinal surgery	241	47 (19.5)	90 (37.3)	306	45 (14.7) <sup>c</sup>	180 (58.8) <sup>c</sup>
Thyroid vascular surgery	130	15 (11.6)	28 (21.5)	184	14 (7.6) <sup>c</sup>	37 (20.1)
Total	625	97 (15.5)	190 (30.4)	810	104 (12.8) <sup>c</sup>	345 (42.6) <sup>c</sup>

<sup>a</sup> Values are frequencies.<sup>b</sup> n, the number of patients with undernutrition or at nutrition risk; %, in terms of percentage.<sup>c</sup> There was a significant difference in the prevalence of undernutrition or nutrition risk among the surgical patients between 2010 and 2017,  $P < .05$  or  $.01$ .**Table 3.** Comparison of the Application of Nutrition Support Among Surgical Patients in 2017 and 2010.<sup>a</sup>

Departments	Patients in 2010 (n, %) <sup>b</sup>			Patients in 2017 (n, %) <sup>b</sup>		
	n	PN	EN	n	PN	EN
Hepato-pancreato-biliary surgery	254	52 (20.5)	8 (3.1)	320	119 (37.2) <sup>c</sup>	61 (19.1) <sup>c</sup>
Gastrointestinal surgery	241	87 (36.1)	27 (11.2)	306	166 (54.2) <sup>c</sup>	107 (34.9) <sup>c</sup>
Thyroid vascular surgery	130	15 (11.5)	0 (0.0)	184	44 (23.8) <sup>c</sup>	22 (12.0) <sup>c</sup>
Total	625	154 (24.6)	35 (5.6)	810	329 (40.6) <sup>c</sup>	190 (23.5) <sup>c</sup>

EN, enteral nutrition; PN, parenteral nutrition.

<sup>a</sup> Values are frequencies.<sup>b</sup> n, the number of patients receiving nutrition support; %, in terms of percentage.<sup>c</sup> There was a significant difference in the application of nutrition support among the surgical patients between 2010 and 2017,  $P < .05$  or  $.01$ .**Table 4.** Association of Nutrition Support With Nutrition Risk Among Surgical Patients in 2017 and 2010.<sup>a</sup>

Departments	Patients in 2010 (n, %) <sup>b</sup>			Patients in 2017 (n, %) <sup>b</sup>		
	n	Nutrition Support in At-Risk Patients	Nutrition Support in Not-At-Risk Patients	n	Nutrition Support in At-Risk Patients	Nutrition Support in Not-At-Risk Patients
Hepato-pancreato-biliary surgery	254	32 (44.4)	20 (13.6)	320	82 (64.1) <sup>c</sup>	32 (16.7)
Gastrointestinal surgery	241	52 (57.8)	35 (33.6)	306	144 (80.0) <sup>c</sup>	52 (41.3) <sup>c</sup>
Thyroid vascular surgery	130	9 (32.1)	6 (6.9)	184	18 (48.6) <sup>c</sup>	41 (28.0) <sup>c</sup>
Total	625	93 (48.9)	61 (18.0)	810	244 (70.7) <sup>c</sup>	125 (26.9) <sup>c</sup>

<sup>a</sup> Values are frequencies.<sup>b</sup> n, the number of patients who received nutrition support; %, in terms of percentage.<sup>c</sup> There was a significant difference in the nutrition support rate of the surgical patients, at or not at nutrition risk, between 2010 and 2017,  $P < .05$  or  $.01$ .

### Change in Applications of Nutrition Support

The rate of the application of nutrition support was 40.6% (329/810) for PN and 23.5% (190/810) for EN among the patients in 2017. The average ratio of PN to EN (1.7:1) in 2017 was lower than that (4.4:1) in 2010. Statistical analysis showed that the application of nutrition support (both EN and PN) among the patients in 2017 in any surgical department was significantly higher than that among the patients in 2010 ( $P < .05$  or  $P < .01$ ). The highest nutrition support rate was found in patients undergoing gastrointesti-

nal surgery (PN 54.2%, EN 34.9%). These details are shown in Table 3.

### Change in the Association of Nutrition Support With Nutrition Risk Among the Patients

The nutrition support rates for different surgical departments, with or without nutrition risk, are shown in Table 4. A total of 244 patients at nutrition risk (NRS-2002 score  $\geq 3$ ) received nutrition support (70.7%), whereas 125 patients not at nutrition risk also received nutrition support (26.9%)

in 2017. The nutrition support rate of the patients, at or not at nutrition risk, in 2017 was significantly higher than that in 2010 ( $P < .05$ ).

## Discussion

To accurately detect patients at nutrition risk, an easy-to-apply, not time-consuming, reliable nutrition risk screening tool is needed. Thus, ESPEN recommends the use of NRS-2002 in hospitalized patients.<sup>10</sup> In China, the suitability of NRS-2002 in hospitalized patients was examined by Chen et al,<sup>13</sup> who showed that 90.8% of patients could be screened by NRS-2002 for detecting nutrition risk. Furthermore, a national survey including 15,098 patients from a total of 19 hospitals in 13 Chinese cities indicated that NRS-2002 can be utilized for 99.2% of hospitalized patients in China,<sup>2</sup> which further demonstrated the suitability of NRS-2002 for hospitalized Chinese patients. Furthermore, to compare with the data collected in 2010, we adopted the same nutrition risk screening tool (NRS-2002) to screen the surgical patients in our study.

In the present study, the prevalence of undernutrition among general surgery patients in 2017 was 12.8%, which is consistent with previous reports from a national survey including 19 hospitals (11.7%)<sup>2</sup> and 5034 general surgical patients in Shanghai hospital (10.1%)<sup>15</sup> but lower than that in 2 surveys conducted among hospitalized patients (nutritionDay 2015/2016 survey in China).<sup>7,18</sup> Moreover, our study found that the rate of undernutrition among the patients in 2017 was lower than that in 2010 (15.5%).<sup>19</sup> Given the common view that the undernutrition rate was higher among the general surgery patients because surgery and dysfunction of the digestive system may result in metabolic disorders and dietary changes, our findings seem surprising. However, if we note that the changes occurred among the people in Southwest China from 2010 to 2017, for example, a period of increasing economic level and living standard and the improvement of physical status, our findings can be accepted.

Unfortunately, we found that the nutrition risk rate in 2017 (42.6%) was higher than that in 2010 (30.4%)<sup>19</sup> among the surgical patients in the same hospital. The highest prevalence of nutrition risk (58.8%) was found in the gastrointestinal surgery patients, which was similar to the studies reported in Beijing teaching hospitals<sup>17</sup> and Guangzhou hospitals.<sup>14</sup> This phenomenon partly reflected that some patients who seemed to possess a current normal BMI before receiving medical treatment may have been at nutrition risk. It is not hard to imagine that some patients not deemed to be at risk upon admission also might reduce their food intake and, thus, become at nutrition risk because of antibiotic treatment or an infectious condition during hospitalization. Hence, simple anthropometric parameters

may underestimate the nutrition risk and miss a portion of patients who truly need nutrition intervention.

Interestingly, our study revealed that a significantly greater proportion of the patients received nutrition support in 2017 compared with 2010, especially EN (23.5% vs 5.6%). Moreover, the application of PN was observed in a large proportion of patients (40.6%), which was consistent with the result from the Nutrition Day 2016 survey in China (38.4%)<sup>18</sup> but higher than those of prospective studies.<sup>1,2,14,16,17,22</sup> We found that the average ratio of PN to EN was 1.7:1 in 2017, which was lower than the ratio (4.4:1) in 2010. All of the above studies reflected a phenomenon commonly existing in most clinical departments of hospitals in China, especially the surgical departments, in which many doctors preferred adopting PN instead of EN for their patients who need nutrition support. The above phenomenon was partially due to the different social environments and economic statuses of China compared with other countries. In contrast to developed countries,<sup>16</sup> the very large population in China leads to a lack of medical resources and a shortage of medical insurance. For Chinese patients, PN can be partially reimbursed, whereas they must pay for EN by themselves. Furthermore, PN is often considered to be an “easier way” to deliver nutrients than EN for doctors in China. In the present study, 70.7% of patients at nutrition risk were given nutrition support, which was consistent with the studies conducted in some large hospitals in our countries.<sup>14,15,17</sup> In a Beijing teaching hospital, 1 study found that the rate of nutrition support application was 62.2% among the surgical patients at nutrition risk.<sup>17</sup> In Shanghai, a study carried out in 5034 general surgical patients showed that 44.5% of patients at nutrition risk received nutrition support.<sup>15</sup> Another survey from 4 teaching hospitals in Guangzhou indicated that  $\approx 35.6\%$  of general surgery patients were at nutrition risk, and  $\approx 51.3\%$  of those people received nutrition intervention.<sup>14</sup> However, we found that inappropriate application of nutrition support, such as the lack of nutrition support for patients at nutrition risk and the overuse of nutrition support for nonrisk patients, also existed among the surgical patients in our hospital. Our study indicated that the nutrition support rate of the patients in 2017, with or without nutrition risk, was significantly higher than that of the patients in 2010. Approximately 26.9% of patients without nutrition risk also received nutrition support in 2017, which is higher than the rate in previous studies in our country.<sup>2,14,15,17</sup> There are several possible reasons for our finding. First, with the development of clinical nutrition, the nutrition status of surgical patients has received increasing attention from surgeons in most hospitals. Thus, regardless of the patient's nutrition risk, their doctors are inclined to apply nutrition intervention to the patient according to the appearance of their patients. Second, many clinical practices that were not based on nutrition-related guidelines or protocols still



exist in some hospitals. Furthermore, as far as we know, formalized nutrition support teams (NSTs) for patients have not existed in most Chinese hospitals. The absence of the NST could explain, at least in part, the phenomena of inappropriate application of nutrition support in patients. Finally, undernutrition in most hospitals is often ignored in diagnoses because of unawareness or lack of appropriate nutrition screening tools, which also leads to inappropriate use of nutrition support among patients. Thus, our finding may suggest that knowledge of nutrition status, which is a predictor of adverse clinical outcomes, is essential not only for general surgical patients or physicians but also for clinical departments and the entire hospital.

There are some limitations to our study. First, our analysis did not include any inpatient whose anthropometric measurements were not suitable because of poor medical condition, which may have led to a selection bias and limited the generalizability of our study. Second, the data collected in this study are cross-sectional. Thus, although the changes in nutrition status and the application of nutrition support among hospitalized general surgery patients between 2011 and 2017 were reflected in our study, we were not able to determine the clinical outcomes of the changes. Third, the sample size in our survey may not be representative of the entire population of hospitalized patients in Southwest China. Thus, further studies focusing on the clinical outcomes of surgery patients with different nutrition interventions would be useful.

Our study has several strengths. First, as far as we know, this is the first study to compare the prevalence of nutrition risk, undernutrition, and the application of nutrition support over a 7-year period among the general surgery patients in the same surgical departments in 1 hospital. Second, to increase the comparability of the 2 periods, we applied NRS-2002 as the nutrition risk screening tool during both periods, and investigators were well trained according to the same standardized procedures. In addition, the standing height and body weight of patients were based on duplicate measurements instead of self-reported data or the patient's medical records.

## Conclusions

The nutrition status among general surgery inpatients changed from 2017 to 2010. The prevalence of undernutrition declined, whereas the prevalence of nutrition risk increased in general surgery inpatients. The application of nutrition support significantly increased, whereas inappropriate uses of nutrition support still existed. Therefore, NSTs and nutrition support guidelines or protocols should be adopted or used to assist the clinical nutrition practice among general surgery inpatients in Chinese hospitals in the future.

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## Statement of Authorship

X. Zhou contributed to the conception and design of the research. X. Wu, B. Deng and L. Huang contributed to the acquisition of the data. X. Zhou contributed to analysis and interpretation of the data. X. Zhou drafted the manuscript. All authors critically revised the manuscript, agree to be fully accountable for ensuring the integrity and accuracy of the work, and read and approved the final manuscript.

## Supplementary Information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

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