

## Piloting a Patient-based Questionnaire to Assess Patient Satisfaction with the Process of Orthodontic Treatment

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### ABSTRACT

**Objective:** To test the scientific properties of a patient-based questionnaire developed to measure adolescent patient's satisfaction with the process of orthodontic treatment.

**Materials and Methods:** Forty-nine consecutive patients aged 9 to 17 years undergoing orthodontic treatment were asked to complete the questionnaire on two separate occasions. Test-retest reliability, readability, ease of administration, criterion validity, and construct validity were tested. All patients answered the questionnaire at time 1 and took part in the construct validity study. Ten patients took part in an ease of administration study and 17 patients took part in the criterion validity study.

**Results:** Thirty-one patients completed the questionnaire at time 2, giving a response rate of 63.3%. The test-retest reliability was excellent in one section, moderate in six sections, and poor in one. The questionnaire had a Flesch Reading Score of 79.8, equivalent to a reading age of 10 years and was easily administered in 5 to 15 minutes. Although the construct validity of the questionnaire was excellent in five of the six measures and moderate in the other, the criterion validity was poor for 7 of the 14 items selected to test.

**Conclusion:** This pilot study demonstrates the need to test a questionnaire before use in audit or research. (*Angle Orthod.* 2009;79:759–765.)

**KEY WORDS:** Questionnaire; Pilot; Satisfaction

### INTRODUCTION

Orthodontists, like other health care professionals, rely on patient cooperation for successful treatment outcomes, and an important factor in this success is patient satisfaction with the delivery of their care. Although there are professional measures of treatment

success, such as the Peer Assessment Rating,<sup>1</sup> at present there are no accepted measures of patient satisfaction, with either the process or outcome of treatment within the United Kingdom. Measures have been developed in Continental Europe and the United States, but because of differences in funding and patients' attitudes, these may not be valid within the United Kingdom.<sup>2–5</sup>

Assessments of the quality of health care can be based on patient, parental, and professional perspectives, or a combination of the three. Although there is evidence that adult<sup>6</sup> and adolescent<sup>7</sup> patients can provide reliable judgments on their health care experience, there is some concern that parental reports, although valid, should not substitute for child reports. This is because such reports may be affected by parental anxiety, previous experience, and levels of education.<sup>8</sup>

A number of factors may influence patient satisfaction, including physical comfort, emotional support, patients' expectations, and respect for patient preference.<sup>6,9,10</sup> Previous measures of patient satisfaction

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Accepted: October 2008. Submitted: June 2008.

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with dental treatment have been broadly based on clinicians' perceptions, which may lack validity and/or reliability.<sup>11</sup> It is now recognized that to be of value, patient satisfaction measures should be based on the issues that are important to patients. Most studies have examined issues that concern parents, rather than patients, and have used measures developed by professionals without patient input. Only four studies<sup>3,5,12,13</sup> have focused on patients' opinions. Although some have examined satisfaction with both process and outcome,<sup>12</sup> others have examined each separately.<sup>3,5,14</sup> The only qualitative study previously undertaken to examine satisfaction with treatment process showed that all patients expressed some dissatisfaction, even though they were satisfied with their outcomes. Thus, treatment process and outcome may not be correlated, and there may be important differences between patients', parents', and orthodontists' perceptions of process.<sup>12</sup>

In the development of a questionnaire to measure patient perceptions and satisfaction with the process of care, there are three stages.<sup>15</sup> The items for investigation are first generated through qualitative research centered on focus groups. Second, a questionnaire is designed using these items and then evaluated to ensure it does not contain ambiguous or leading questions. Finally, the questionnaire is tested for readability, reliability, validity, and ease of administration.<sup>16</sup> Although reliability refers to the reproducibility, consistency, and homogeneity and the degree to which it is free from random error,<sup>12,16</sup> validity refers to the degree that a measure is an accurate reflection of what it is designed to measure.<sup>17</sup>

A patient-centered questionnaire to assess satisfaction with the process of orthodontic healthcare delivery in the United Kingdom had previously been developed using focus groups<sup>18</sup> and had good face and content validity. However, it was not tested for readability, ease of administration, reliability, criterion validity (how well the criteria match objective measures), or construct validity (the degree to which a test measures a theoretical construct for which there are no predefined measures). The investigation reported here aimed to determine these properties.

## MATERIALS AND METHODS

Ethical committee approval was obtained from the Plymouth (local research ethics committee [LREC] 1960), Solihull (LREC Q15/03), and United Bristol Healthcare Trust (LREC E5604) LRECs. In an earlier qualitative study,<sup>18</sup> issues of importance to adolescent orthodontic patients were identified. Subsequently, a questionnaire was developed to examine how children and adolescents perceive the delivery of orthodontic

care. The sections of the questionnaire included the following:

- Age, gender, type of appliance, and length of treatment (sections A and B)
- Reasons for treatment (section C)
- Visiting the orthodontist (section D)
- Having treatment (section E)
- Information on braces before treatment (section F)
- Wearing a brace (section G)
- Problems with wearing a brace (section H)

### Test-retest Reliability

To test reliability, 49 patients undergoing active orthodontic treatment at either a hospital orthodontic department (Derriford Hospital, Plymouth, UK) or one of two High Street specialist practices (Plymouth and Solihull, UK) were approached to take part in this study. The patients and their parents were given written information on the study. Once written consent had been obtained, the patients were asked to complete the questionnaire with the researcher present (T1). The questionnaire was subsequently posted to each participant 12 to 14 weeks later. They were asked to complete it and post it back using a stamped addressed envelope (T2). The responses for the first and second completion of the questionnaire were coded, and the results were analyzed using SPSS software (SPSS Inc, SPSS Version 11.1. Chicago, Ill). The agreement between the results was calculated using Kappa values for nominal data.<sup>19</sup>

### Determination of Readability

The readability of the questionnaire was tested using the Flesch Reading Ease Score and Flesch-Kincaid Grade Level readability statistics (Microsoft Word 2002, Microsoft Corporation, Redmond, Wash).

### Ease of Administration

Ten patients (nine were wearing fixed appliances) attending a routine orthodontic appointment participated in the study at T1. Three were male and seven were female (mean age = 12 years). The time taken by each participant to complete the questionnaire was recorded by the researcher (AM) using a stopwatch.

### Criterion Validity Testing

The researcher undertook structured telephone interviews (see Appendix) on a weekday evening with 17 randomly selected participants, 6 to 8 weeks after completion of the questionnaire (T1). A range of questions were selected from the questionnaire to include in the interview and were chosen because their validity

**Table 1.** Median (and Range) Value of Kappa for Items Within Each Section of the Questionnaire

| Question  | Kappa Coefficient | Strength of Agreement | Spearman's rho |
|---|-------------------|-----------------------|----------------|
| Section A:  | 0.89              | 4                     |                |
| Demographics                                      | (0.23 to 1.00)    |                       |                |
| 1   |                   |                       | 0.971          |
| 2   | 0.91              | Excellent             |                |
| 3   | 1.00              | Excellent             |                |
| 4i  | 0.30              |                       |                |
| 4ii   | No entries        |                       |                |
| 4iii  | 0.95              | Excellent             |                |
| 4iv   | No entries        |                       |                |
| 5   | 0.23              | Fair                  |                |
| Section B: Type of appliance                      | 0.48              | 3                     |                |
|   | (0.25 to 0.55)    |                       |                |
| 1   | 0.48              | Moderate              |                |
| 2   | 0.55              | Moderate              |                |
| 3   | 0.25              | Fair                  |                |
| Section C: Reasons for treatment                  | 0.19              |                       |                |
| 1i  | 0.02              | Poor                  |                |
| 1ii   | 0.02              | Poor                  |                |
| 1iii  | 0.70              | Good                  |                |
| 1iv   | No entries        |                       |                |
| 1v  | No entries        |                       |                |
| 2i  | 0.47              | Moderate              |                |
| 2ii   | 0.01              | Poor                  |                |
| 2iii  | 0.19              | Poor                  |                |
| 2iv   | 0.43              | Moderate              |                |
| 2v  | 0.48              | Moderate              |                |
| 2vi   | 0.06              | Poor                  |                |
| 2vii  | No entries        |                       |                |
| 2viii   | No entries        |                       |                |
| Section D: Visiting the orthodontist              | 0.49              | 7                     |                |
|   | (0.11 to 0.88)    |                       |                |
| 1   | 0.42              | Moderate              |                |
| 2   | 0.11              | Poor                  |                |
| 5   | 0.37              | Fair                  |                |
| 6   | 0.88              | Excellent             |                |
| 7a  | 0.66              | Good                  |                |
| 7b  | 0.64              | Good                  |                |
| 8   | 0.49              | Moderate              |                |
| Section E: Having treatment                       | 0.43              | 5                     |                |
|   | (0.06 to 0.67)    |                       |                |
| 1   | 0.43              | Moderate              |                |
| 2   | 0.06              | Poor                  |                |
| 3   | 0.67              | Good                  |                |
| 4   | 0.55              | Moderate              |                |
| 5   | 0.39              | Fair                  |                |
| Section F: Information on braces before treatment | 0.41              | 21                    |                |
|   | (0.01 to 0.70)    |                       |                |
| 1i  | 0.06              | Poor                  |                |
| 1ii   | 0.01              | Poor                  |                |
| 1iii  | 0.52              | Moderate              |                |
| 1iv   | 0.04              | Poor                  |                |
| 1v  | 0.03              | Poor                  |                |
| 1vi   | No entries        |                       |                |
| 1vii  | No entries        |                       |                |
| 2i  | 0.08              | Poor                  |                |
| 2ii   | 1.00              | Excellent             |                |
| 2iii  | 0.02              | Poor                  |                |

**Table 1.** Continued

| Question                                 | Kappa Coefficient | Strength of Agreement | Spearman's rho |
|--|-------------------|-----------------------|----------------|
| 2iv                                      | 0.11              | Poor                  |                |
| 2v                                       | 0.59              | Moderate              |                |
| 2vi                                      | 0.02              | Poor                  |                |
| 2vii                                     | No entries        |                       |                |
| 2viii                                    | No entries        |                       |                |
| 3  | 0.70              | Good                  |                |
| 4  | 0.55              | Moderate              |                |
| 5  | 0.59              | Moderate              |                |
| 6  | 0.41              | Moderate              |                |
| 7  | 0.59              | Moderate              |                |
| 8  | 0.42              | Moderate              |                |
| Section G: Wearing a brace               | 0.51              | 4                     |                |
|  | (0.42 to 0.66)    |                       |                |
| 1  | 0.42              | Moderate              |                |
| 2  | 0.54              | Moderate              |                |
| 3  | 0.48              | Moderate              |                |
| 4  | 0.66              | Good                  |                |
| Section H: Problems with wearing a brace | 0.58              | 3                     |                |
|  | (0.52 to 0.66)    |                       |                |
| 1  | 0.58              | Moderate              |                |
| 2  | 0.66              | Good                  |                |
| 3  | 0.52              | Moderate              |                |

could not be confirmed from the orthodontic records. A variety of response formats were selected, including checklist and Likert scale answers. The latter were inverted to those in the questionnaire and were described in full before the participant answered. The scale ranged from 3 to 5, and the responses included very difficult, difficult, okay, easy, and very easy.

Checklist answers were coded for prompted and unprompted responses, and the researcher asked the questions in a standard format. The data from the interviews were compared with the questionnaire responses from T1. Measurements of agreement for this nominal data were analyzed using the Kappa statistic.

**Construct Validity Testing**

Construct validity was assessed by relating the questionnaire responses (T1) to data recorded in the individual's orthodontic records, such as length of treatment and type of appliance. Clinical data were compared with the questionnaire responses from T1. For example, length of treatment was compared to the responses to question B3, "When did you first start wearing the brace you have now?" Measurements of agreement were determined with the Kappa statistic for nominal data and Spearman's rank correlation coefficient for continuous data.

**RESULTS**

Forty-nine patients undergoing active orthodontic treatment agreed to take part in the initial part of this

**Table 2.** Reading Ease and Grade-level Scores for Questionnaire Format

| Questionnaire | Flesch Reading Ease | Flesch-Kincaid Grade Level |
|---------------|---------------------|----------------------------|
| 1 (T1)        | 79.2                | 4.9                        |
| 2 (T2)        | 79.8                | 4.8                        |

study (T1), 20 males and 29 females (mean age = 13.9 years; age range = 9 to 17 years). Forty patients were wearing fixed appliances and nine removable appliances. Thirty-one patients responded to the same questionnaire posted to them 12 to 14 weeks later (T2), giving a response rate of 63.3%.

### Test-retest Reliability Results

The Kappa values are summarized in Table 1 and show excellent or moderate agreement for all sections, except section C. The specific questions where reliability was moderate were as follows:

- C1 Whose idea was it for you to see the orthodontist about a brace?  
 C2 What would you like your brace to do for you?

### Readability Results

The questionnaire had a Flesch Reading Score of 79.8, which is equivalent to a reading age of 10 years. When converted to a Flesch-Kincaid Grade Level score (4.8), it showed good levels of readability, being scored at a US grade 5, or a 10-year-old reading ability (Table 2). The average reading age in the United Kingdom is 12 years, and the questionnaire, therefore, should have been readable for the majority of the study population, which ranged in age from 9 to 17 years (mean age = 13.9 years).

### Ease of Administration Results

The time taken to complete the questionnaire ranged from 5 to 15 minutes. The median and mode time for completing the questionnaire was 7 minutes.

### Criterion Validity Results

Seventeen patients took part in this section of the study. Each interview took between 5 and 10 minutes. Table 3 shows the extent of agreement between the responses of the telephone interview and the questionnaire (T1). Agreement was observed to be poor with 50% of the items tested. The median value of kappa for the criterion question was only 0.27, but the range was 0.06 to 0.77.

**Table 3.** Value of Kappa Between T1 and the Telephone Interview in Criterion Validity Study

| Question  | Value of Kappa  | Strength of Agreement |
|-----------|---|-----------------------|
| Section C | 0.34 (0.08 to 0.61)                                   |                       |
| 1i        | 0.34  | Fair                  |
| 1ii       | 0.61  | Good                  |
| 1iii      | 0.46  | Moderate              |
| 1iv       | No statistic produced as T1 constant                  |                       |
| 1v        | No statistic produced as T1 constant                  |                       |
| 2i        | No statistic produced as telephone interview constant |                       |
| 2ii       | 0.08  | Poor                  |
| 2iii      | 0.45  | Moderate              |
| 2iv       | 0.09  | Poor                  |
| 2v        | No statistic produced as telephone interview constant |                       |
| 2vi       | 0.08  | Poor                  |
| 2vii      | No statistic produced as telephone interview constant |                       |
| 2viii     | No statistic produced as telephone interview constant |                       |
| Section E |   |                       |
| 5         | 0.41  | Moderate              |
| Section F | 0.11 (0.06 to 0.77)                                   |                       |
| 2i        | 0.06  | Poor                  |
| 2ii       | 0.77  | Good                  |
| 2iii      | 0.06  | Poor                  |
| 2iv       | 0.20  | Poor                  |
| 2v        | 0.11  | Poor                  |
| 2vi       | No statistic produced as telephone interview constant |                       |
| 2vii      | No statistic produced as telephone interview constant |                       |
| 2viii     | No statistic produced as T1 constant                  |                       |
| Section H |   |                       |
| 3         | 0.47  | Moderate              |

### Construct Validity Results

Levels of agreement are shown in Table 4. Of the items used to assess construct validity, one item was in the moderate range of agreement and five were in the excellent range of agreement.

### DISCUSSION

The questionnaire was assessed for reliability, readability, ease of administration, and validity. Forty-nine patients completed the questionnaire at T1 and all were included in the construct validity study. However, a subgroup of only 17 patients was included in the criterion validity study because of recruitment difficulties. The questionnaire was posted to all of the original participants in order to undertake the test-retest reli-

**Table 4.** Value of Kappa or Spearman's Correlation between T1 and Medical Records in Construct Validity Study

| Question | Value of Kappa | Strength of Agreement |
|----------|----------------|-----------------------|
| A2       | 1.000          | Excellent             |
| A5       | 0.91           | Excellent             |
| B1       | 0.95           | Excellent             |
| B2       | 0.91           | Excellent             |
| B3       | 0.42           | Moderate              |

ability study (T2), and 31 responses were received within six weeks. Although the response rate of 63.3% might seem low, anything between 40% and 80% is not necessarily unacceptable,<sup>20</sup> and certainly anything over 50% has been considered by some to be very good.<sup>21</sup> Nonresponse is obviously important as it affects the quality of the data collected and the precision of any inferences. For example, response bias may be introduced if certain groups are less likely to respond.<sup>16</sup> Methods suggested to improve response rates have included making the questionnaire short; using a personalized covering letter<sup>22</sup>; emphasizing confidentiality; allowing participants to withdraw at any time; and using colored ink,<sup>23</sup> a bold logo, and a clear layout.<sup>24</sup> Most of these techniques were used in the present study.

The design of the questionnaire included formatting the questions and responses not only for ease of analysis but also for readability. The latter was found to be at a level suitable for most patients undergoing orthodontic treatment. The wording of each question was structured so as to avoid jargon and therefore misinterpretation.<sup>22</sup> The response format used was mainly closed throughout, although open responses were included and subsequently coded as being present or absent to allow the researcher to interpret them independently.

The ease of administration demonstrated that the questionnaire could be completed within 5 to 15 minutes; ideally, any questionnaire should be as succinct as possible to improve the response rate and ensure that the respondent is capable of answering the important research or audit question. The response rate in this case was reasonably good, which suggests that 10 to 15 minutes is a realistic length of time for this type of satisfaction questionnaire and in this age group.

The results also demonstrated that all sections of the questionnaire had satisfactory test-retest reliability, with the exception of section C. Here the two questions were "Whose idea was it for you to see the orthodontist?" and "What would you like your brace to do for you?" It is well known that many children referred for orthodontic treatment are unaware of the precise reason for their referral.<sup>25</sup> The poor test-retest reliability for these two questions may have been due to a greater awareness of orthodontic treatment on the patient's behalf by the time the questionnaire was completed at T2. A time interval shorter than 12 to 14 weeks might have produced different results for at least one of these questions. Despite low levels of reliability, these questions addressed important aspects of the process of orthodontic care, as identified by patients in a previous qualitative study.<sup>18</sup> However, the

use of these data should be treated with caution when assessing the same respondent over time.

The face and content validity of this questionnaire were assumed to be good, as the questions were a reflection of the experiences discussed in the previous focus groups with child and adolescent patients.<sup>18</sup> Although the questionnaire showed excellent construct validity, it showed poor criterion validity. There are three possible reasons for this. First, the measure itself is not valid. Second, there were methodologic differences between the telephone interviews and the written questionnaire. And third, a telephone interview may not be the best method of testing validity. An alternative would have been to assess the questionnaire against a similar measure in the published literature.<sup>17</sup> However, there is currently no such gold standard measure available.

Construct validity is the extent to which the instrument tests the hypothesis or theory it is measuring. The scale should correlate with related variables; for example, a patient's report of length of treatment should be correlated with information recorded in their orthodontic notes. As already stated, the construct validity was excellent.

The present investigation illustrates the need to perform a pilot study in order to test parameters such as readability, ease of administration, reliability, and validity before the use of a patient satisfaction questionnaire if erroneous results are not to be produced. This has not always been the case with other questionnaire-based studies. For example, O'Connor<sup>3</sup> used a clinician-based free-form questionnaire to assess patient perceptions of the delivery of orthodontic treatment. Depending on their stage of treatment, patients were asked to respond to their fears or apprehensions before treatment, greatest dislikes during treatment, and any recommendations for orthodontists after treatment. No mention of validity or reliability testing of these measures was made. Tung and Kiyak<sup>13</sup> found that both patients and their parents expected that the greatest benefit from treatment would be an improvement in self-image and oral function. However, the questionnaire used was merely adapted from those used in other studies. The use of questionnaires in audit and research is important, as there is evidence that improving patient satisfaction may positively affect treatment outcome by influencing compliance and therefore treatment quality.<sup>26</sup> Reliable information on patient satisfaction is also essential for quality assurance.<sup>27</sup>

As with all questionnaires, some caution should be exercised when interpreting the results. In this study the criterion validity was poor in 50% of responses, and it could be argued that the sample size was small. However, this was a pilot study to assess specific sci-

entific parameters of a newly developed patient satisfaction questionnaire. It can be seen from the results that a questionnaire has been produced that is readable by the patient group of 10 years and older, is easy to administer, is reliable, and has good construct validity. It may therefore serve as a useful adjunct to existing clinical measures in future research and audit into patient satisfaction.

## CONCLUSIONS

- The newly developed patient satisfaction questionnaire had good levels of readability, ease of administration, reliability, and construct validity.
- Test-retest reliability may be influenced by the patient experience and therefore the time interval between the test and retest.
- The response rate was disappointing, but it highlights the difficulties with recruitment in such studies.
- Criterion validity was poor in some instances, which may be related to sample size or interview method, but there is currently no gold standard available against which to test this.
- The results also illustrate the need to carefully pilot the scientific parameters of any questionnaire before use in order to avoid incorrect inferences being made as a result of any findings.

## ACKNOWLEDGMENT

The authors would like to thank the clinicians treating the patients for their help in this study.

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**APPENDIX**

**Criterion Validity Data Collection Form: Structured Telephone Interview**

C1) Whose idea was it for you to see the orthodontist about a brace?

|                            | Unprompted               | Prompted                 |
|----------------------------|--------------------------|--------------------------|
| <b>Your dentist's idea</b> | <input type="checkbox"/> | <input type="checkbox"/> |
| <b>Your parents' idea</b>  | <input type="checkbox"/> | <input type="checkbox"/> |
| <b>Your idea</b>           | <input type="checkbox"/> | <input type="checkbox"/> |
| <b>Someone else's idea</b> | <input type="checkbox"/> | <input type="checkbox"/> |
| <b>Who?</b>                |                          |                          |
| <b>Can't remember</b>      | <input type="checkbox"/> | <input type="checkbox"/> |

C2) What would you like your brace to do for you?

|                                   | Unprompted               | Prompted                 |
|-----------------------------------|--------------------------|--------------------------|
| <b>Make me more confident</b>     | <input type="checkbox"/> | <input type="checkbox"/> |
| <b>Make my smile nicer</b>        | <input type="checkbox"/> | <input type="checkbox"/> |
| <b>Straighten my teeth</b>        | <input type="checkbox"/> | <input type="checkbox"/> |
| <b>Make my teeth more healthy</b> | <input type="checkbox"/> | <input type="checkbox"/> |
| <b>Stop people teasing me</b>     | <input type="checkbox"/> | <input type="checkbox"/> |
| <b>Improve my appearance</b>      | <input type="checkbox"/> | <input type="checkbox"/> |
| <b>Other</b>                      | <input type="checkbox"/> | <input type="checkbox"/> |
| <b>I don't know</b>               | <input type="checkbox"/> | <input type="checkbox"/> |

E3) The orthodontist answers my questions.

| Never                    | Hardly ever              | Sometimes                | Most of the time         | Always                   |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 1                        | 2                        | 3                        | 4                        | 5                        |

E5) The orthodontist explains any treatment before he or she begins.

| Never                    | Hardly ever              | Sometimes                | Most of the time         | Always                   |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| 1                        | 2                        | 3                        | 4                        | 5                        |

F2) Before you started treatment how were you given information about brace treatment?

|  |                          |
|--|--------------------------|
| <b>I was given a leaflet</b>                       | <input type="checkbox"/> |
| <b>I watched a video</b>                           | <input type="checkbox"/> |
| <b>My orthodontist talked to me</b>                | <input type="checkbox"/> |
| <b>Someone else at the clinic talked to me</b>     | <input type="checkbox"/> |
| <b>My orthodontist showed me photographs</b>       | <input type="checkbox"/> |
| <b>Someone else at the clinic showed me photos</b> | <input type="checkbox"/> |
| <b>I didn't get any information</b>                | <input type="checkbox"/> |
| <b>Can't remember</b>                              | <input type="checkbox"/> |

H3) Would you recommend having a brace to a friend?

|            |                          |
|------------|--------------------------|
| <b>Yes</b> | <input type="checkbox"/> |
| <b>No</b>  | <input type="checkbox"/> |