Application of Tennessee Value-Added Assessment System in The Quality Management of Clinical Bedside Teaching Base

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Research Article

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Abstract

Background: Compared with foreign countries, China's education evaluation system mostly adopts the method of simple comparison of students' average scores, and the evaluation results are relatively simple; It is a top-down, one-way and appraisal evaluation system, which not only can not form information feedback network, but also can not fully mobilize the enthusiasm and initiative of the evaluation subject and the evaluation object. As a value-added evaluation model, TVAAS can provide multi-dimensional information and has been widely used in foreign countries. Therefore, we need to learn from the Tennessee value-added evaluation model system, and a series of domestic studies have proved that value-added evaluation should be an important part of school evaluation.

Results: The evaluation indexes of grade 2016 students were significantly better than that of grade 2015 students, and there was statistical differences between the two groups' evaluation indexes (P < 0.05).

Conclusion: To a certain extent, "Tennessee Value-Added Assessment System" can objectively evaluate the growth rate of teaching quality of clinical bedside teaching bases, and evaluate the correlation between relevant education reform measures and teaching quality improvement scientifically, which is proposed for further popularization and application.

Introduction

In the 1990s, improving the academic performance of all students and paying attention to the academic growth of students were raised to an unprecedented height in the United States. The traditional teaching evaluation model was questioned and the value-added evaluation model emerged as the times required. One of the earliest and highly influential models is Tennessee Value-Added Assessment System in the United States [1], proposed by William Sanders, a statistician at the university of Tennessee. William Sanders conducted empirical research on this aspect. At present, TVAAS has been widely applied in the world [2-3]. According to Bennett, value-added evaluation means to examine the development of students' ability and knowledge after they have experienced university learning. Value-added means the differences between students' harvest after they finish their studies and that before they start their studies, which is exactly the difference brought by their university education [4].

Tennessee Value-Added Assessment System is widely used throughout the world, which is inseparable from its characteristics. The details are as follows: (1) comply with the students' individual differences: the basic idea of TVAAS is that schools and teachers should adopt various teaching methods, respect the individual differences among students, ensure that students at all levels can obtain the opportunity of academic progress. (2) Emphasis on students' developmental process: TVAAS evaluates students' progress before and after learning by longitudinal developmental measurement, so as to see the academic progress brought by schools and teachers to students. (3) Respect students' principal position: the essence of TVAAS is to constantly track the whole learning process of students and pay attention to the development of students. It surpasses the previous higher education evaluation model, makes the
higher education evaluation return to the student standard and pays attention to the student's learning quality.

TVAAS, as a kind of evaluation model which emerged in response to the social need of the government to evaluate student effectiveness on a large scale, has gradually become an international trend, and has important practical value of education in our country as well. In terms of school, measuring the result of teachers’ work and students’ learning via students’ progress, compared with the traditional measurement based on the test scores, is an innovation of teachers’ and students’ evaluation methods. TVAAS can provide accurate analysis results, serve the formulation of school strategic decisions, the renewal of talent training program, curriculum reform, etc., promote the continuous improvement in teaching quality, and make it develop towards a scientific and fair direction. As far as teachers are concerned, value-added evaluation can enable them to have a better perception of medical education, gain a deeper understanding of the students' academic progress process, and study teaching and learning, so as to promote the innovation of teaching and learning and provide students with a more reasonable teaching mode. From the perspective of students, the implementation of TVAAS will greatly promote their progress. Some foreign scholars believe that value-added evaluation, as a measurement method of student development, is a better indicator than exam results, and can better measure students' potential and guide their development\[5\]. It promotes the progress of students by affirming their value-added potential and giving help according to the characteristics of each student.

Therefore, this study applies TVAAS to evaluate the teaching situation of training students in clinical teaching base of medical university, to prove the advantage of TVAAS in improving students’ teaching satisfaction, promoting teachers’ teaching methods, and inspiring medical colleges and universities to carry out teaching reform, so as to explore the way of teaching quality evaluation and management suitable for clinical teaching base of clinical medical college and improve the teaching quality and effect.

**Methods**

1.1 General information:

The college stipulates that students majoring in clinical medicine should enter teaching base of bedside teaching in the fourth year. In this study, students from 2015 grade and 2016 grade were selected, and there was no difference in general data between the two groups (P > 0.05), indicating comparability.

1.2 Clinical bedside teaching base:

In this study, 5 clinical teaching bases were selected as research objects, namely, teaching bases A, B, C, D and E.

1.3 Observation index:
1.3.1 Objective evaluation: Combined with the final exam scores of all clinical medicine students of grade 2015 and 2016 in their junior and senior years, the average scores of junior and senior students in each teaching base were compared.

1.3.2 Subjective evaluation: a self-made satisfaction survey scale was used to investigate students' own ability, teaching environment of the base, teachers' teaching, information feedback system of teachers and students and other aspects, and the options of very satisfied, satisfied, general, dissatisfied and very dissatisfied were given respectively. In this study, the questionnaire has a fine structural validity (KMO value was 0.96 and 0.94, respectively) and internal consistency reliability (coefficient was 0.98 and 0.97, respectively).

1.4 Statistical analysis:

The data recorded in the study were processed and analyzed by statistical software SPSS 17.0. The measurement data were expressed as mean ± standard deviation, and analyzed by analysis of variance between groups. When P<0.05, the difference was statistically significant.

Results

2.1 Comparison of Student academic performance

The grades of 2015 and 2016 students who were conducted bedside teaching in the teaching base E both had higher scores in the senior year; the grades 2015 students in the teaching base C also showed a decline, while the grade 2016 students showed an increase; The junior grades all in the teaching base B showed an increase compared with the senior grades, but the value-added declined slightly, as shown in Table 1.

Table 1 Analysis of academic Performance points of clinical medical students of grade 2015 and 2016 in their junior and senior years

| YEAR      | Teaching base E |       | Teaching base C |       | Teaching base B |       |
|-----------|-----------------|-------|-----------------|-------|-----------------|-------|
|           | Class 1 | Class 2 | Class 3 | Class 4 | Class 5 | Class 6 | Class 4 | Class 5 | Class 6 |
| Grade 2015 | Junior | 82.94   | 81.58   | 81.33   | 81.44   | 82.83   | 82.76   |
|           | Senior  | 82.87   | 81.57   | 81.18   | 81.33   | 82.50   | 83.70   |
|           | Value-added | -0.07   | -0.01   | -0.15   | -0.11   | -0.33   | 0.94    |
| Grade 2016 | Junior | 81.04   | 81.91   | 81.16   | 80.72   |
|           | Senior  | 80.19   | 81.19   | 81.33   | 80.90   |
|           | Value-added | -0.85   | -0.72   | 0.17    | 0.18    |
2.2 Correlation analysis of students' satisfaction with various indicators in the teaching clinical base

2.2.1 Professional theory level, professional operation skills, doctor-patient communication ability, self-professional identity

Compared with 2015 students, 2016 students' satisfaction with the four indicators of teaching base A, C and D all increased significantly, among which the increment of A and C was relatively obvious, while the increment of D was relatively small. However, the degree of satisfaction with teaching base B is in a declining state, with an obvious decreasing index and no increment.

2.2.2 Teaching facilities and sites, clinical diseases, learning opportunities, student management, and base accommodation environment

Compared with 2015 students, 2016 students' satisfaction with the 5 indicators of teaching base A, C and D has increased significantly, among which the increment of A and C is relatively obvious, while the increment of D is relatively small. However, the degree of satisfaction with teaching base B decreased, without increment. It can be seen that the teaching base A, C and D are constantly improving their teaching environment so as to better serve students. However, teaching base B shows a downward trend, which needs to be paid close attention to.

2.2.3 Teaching awareness, teaching methods, teaching attitude, teaching level of specialized courses, teacher feedback and assessment

Compared with 2015 students, 2016 students' satisfaction with the 5 indicators of teaching base A, C and D has increased significantly, among which teaching base A has a significant increase, followed by teaching base D and C. However, the satisfaction degree of teaching base B decreased, without increment. This indicates that teaching base A has adjusted its own teaching mode to make teaching closer to students' personal level and promote students' academic progress. On the contrary, the teaching mode of teaching base B needs to be adjusted urgently.

2.2.4 The help provided by college teachers, the contact and communication between college teachers and guidance teachers of bedside teaching units, the effect of the college's supervision on bedside teaching sites, the students' report on bedside teaching, and the degree of receiving college information unimpeded

Compared with 2015 students, 2016 students' satisfaction with the 5 indicators of teaching base A, C and D has increased significantly, among which the increment of A and C is relatively obvious, while the increment of D is relatively small. However, the satisfaction with five indicators of teaching base B decreased. It can be seen that teaching base A and C rebuilt their teacher-student feedback system, thus making students' satisfaction rise rapidly, while the teacher-student feedback system of teaching base B has been unable to meet the needs of students.
From the perspective of the overall satisfaction increment of each clinical teaching base, the increment of teaching base A and C is relatively obvious, followed by teaching base D, while the overall satisfaction with teaching base B has no increment. See Table 2, 3 and 4 for details.

Table 2 Satisfaction degree of 2015 clinical medical students with various indicators
| Clinical teaching base | Teaching base A  | Teaching base B  | Teaching base C  | Teaching base D  | F  | P     |
|------------------------|------------------|------------------|------------------|------------------|----|-------|
| Professional theory level | 3.70±1.33        | 4.40±0.74        | 3.78±0.82        | 4.09±0.81        | 2.36 | 0.075 |
| Professional operation skills | 3.65±1.34        | 4.40±0.74        | 3.71±0.84        | 4.00±0.87        | 2.47 | 0.66  |
| Doctor-patient communication ability | 3.70±1.33        | 4.47±0.74        | 3.78±0.82        | 4.00±0.82        | 2.54 | 0.06  |
| Self-professional identity | 3.74±1.36        | 4.40±0.74        | 3.86±0.82        | 4.14±0.71        | 2.02 | 0.116 |
| Teaching facilities and sites | 3.65±1.37        | 4.33±0.62        | 3.51±1.21        | 4.36±0.62        | 4.33 | 0.006 |
| Clinical diseases | 3.78±1.31        | 4.40±0.74        | 3.92±0.89        | 4.279±0.88       | 1.89 | 0.136 |
| Learning opportunities | 3.70±1.36        | 4.47±0.64        | 3.98±4.22        | 4.23±0.87        | 2.13 | 0.101 |
| Student management | 3.70±1.33        | 4.53±0.64        | 3.65±0.99        | 4.18±1.01        | 3.63 | 0.015 |
| Base accommodation environment | 3.52±1.34        | 4.60±0.51        | 2.78±1.33        | 4.32±0.95        | 13.99 | 0.000 |
| Teaching awareness | 3.78±1.31        | 4.67±0.62        | 4.22±0.82        | 4.00±0.98        | 2.88 | 0.04  |
| Teaching methods | 3.74±1.32        | 4.47±0.64        | 4.14±0.82        | 4.05±1.05        | 1.81 | 0.15  |
| Teaching attitude | 3.78±1.31        | 4.60±0.63        | 4.14±0.82        | 4.14±0.99        | 2.22 | 0.09  |
| Teaching level of specialized courses | 3.70±1.36        | 4.60±0.63        | 4.14±0.84        | 4.12±0.98        | 2.82 | 0.04  |
| Teacher feedback and assessment | 3.61±1.34        | 4.40±0.83        | 4.12±0.86        | 4.18±0.85        | 2.44 | 0.07  |
| The help provided by college teachers | 3.78±1.35        | 4.47±0.52        | 3.69±1.12        | 4.23±0.75        | 2.87 | 0.04  |
| The contact and communication between college teachers and guidance teachers of bedside teaching units | 3.74±1.36 | 4.40±0.51 | 3.65±1.11 | 4.23±0.75 | 2.95 | 0.04 |
| The effect of the college's supervision on bedside teaching sites | 3.78±1.35 | 4.47±0.52 | 3.71±1.08 | 4.27±0.70 | 3.07 | 0.03 |
| The students’ report on bedside teaching | 3.74±1.39 | 4.33±0.62 | 3.76±0.99 | 3.94±1.02 | 2.45 | 0.07 |
| The degree of receiving college information | 3.57±1.34 | 4.47±0.52 | 3.69±1.06 | 4.27±0.70 | 4.05 | 0.01 |

Table 3 Satisfaction degree of 2016 clinical medical students with various indicators
| Clinical teaching base                                      | Teaching base A | Teaching base B | Teaching base C | Teaching base D | F     | P    |
|------------------------------------------------------------|----------------|----------------|----------------|----------------|-------|------|
| Professional theory level                                  | 4.69±0.62      | 3.68±0.89      | 4.58±0.87      | 4.20±0.89      | 6.62  | 0.000|
| Professional operation skills                              | 4.69±0.62      | 3.82±0.91      | 4.47±1.06      | 4.35±0.88      | 3.97  | 0.005|
| Doctor-patient communication ability                       | 4.65±0.75      | 3.91±0.87      | 4.53±1.03      | 4.30±0.86      | 3.03  | 0.021|
| Self-professional identity                                | 4.77±0.52      | 3.45±1.01      | 4.64±0.83      | 4.35±0.86      | 10.54 | 0.000|
| Teaching facilities and sites                             | 4.85±0.46      | 3.68±0.89      | 4.58±0.97      | 4.40±1.05      | 6.11  | 0.000|
| Clinical diseases                                          | 4.84±0.37      | 3.82±0.91      | 4.47±1.18      | 4.40±0.75      | 4.08  | 0.004|
| Learning opportunities                                     | 4.92±0.27      | 3.90±0.87      | 4.47±1.18      | 4.35±0.81      | 4.64  | 0.002|
| Student management                                         | 4.77±0.82      | 3.45±1.04      | 4.56±1.08      | 4.35±1.04      | 6.69  | 0.000|
| Base accommodation environment                             | 4.58±0.90      | 4.14±0.89      | 4.39±0.99      | 4.45±1.05      | 3.70  | 0.007|
| Teaching awareness                                         | 4.77±0.82      | 3.86±0.77      | 4.47±1.11      | 4.50±0.76      | 3.11  | 0.018|
| Teaching methods                                           | 4.66±0.89      | 3.91±0.75      | 4.47±1.11      | 4.55±0.60      | 2.48  | 0.049|
| Teaching attitude                                          | 4.69±0.88      | 4.05±0.72      | 4.56±1.00      | 4.55±0.60      | 2.19  | 0.075|
| Teaching level of specialized courses                      | 4.54±0.95      | 3.90±0.87      | 4.44±1.18      | 4.40±0.68      | 1.54  | 0.197|
| Teacher feedback and assessment                            | 4.77±0.82      | 3.86±0.99      | 4.47±1.16      | 4.45±0.69      | 2.80  | 0.03 |
| The help provided by college teachers                      | 4.81±0.49      | 4.18±0.85      | 4.64±0.72      | 4.45±0.83      | 4.46  | 0.02 |
| The contact and communication between college teachers and guidance teachers of bedside teaching units | 4.85±0.46      | 4.09±0.87      | 4.67±0.68      | 4.45±0.76      | 4.87  | 0.01 |
| The effect of the college's supervision on bedside teaching sites | 4.85±0.46      | 4.14±0.89      | 4.72±0.61      | 4.40±0.82      | 6.93  | 0.000|
| The students’ report on bedside teaching                   | 4.85±0.46      | 4.09±0.92      | 4.69±0.62      | 4.40±0.82      | 4.98  | 0.001|
| The degree of receiving college information                | 4.77±0.82      | 4.09±0.92      | 4.69±0.62      | 4.40±0.82      | 4.03  | 0.004|

Table 4 Incremental analysis of satisfaction of each clinical teaching base
| Clinical teaching base                                      | Teaching base A | Teaching base B | Teaching base C | Teaching base D |
|------------------------------------------------------------|----------------|----------------|----------------|----------------|
| Professional theory level                                  | 0.99           | -0.72          | 0.8            | 0.11           |
| Professional operation skills                              | 1.04           | -0.58          | 0.76           | 0.35           |
| Doctor-patient communication ability                       | 0.95           | -0.56          | 0.75           | 0.3            |
| Self-professional identity                                 | 1.03           | -0.95          | 0.78           | 0.21           |
| Teaching facilities and sites                              | 1.2            | -0.65          | 1.07           | 0.04           |
| Clinical diseases                                          | 1.06           | -0.58          | 0.55           | 0.12           |
| Learning opportunities                                     | 1.22           | -0.57          | 0.49           | 0.12           |
| Student management                                         | 1.07           | -1.08          | 0.91           | 0.17           |
| Base accommodation environment                             | 1.06           | -0.46          | 1.61           | 0.13           |
| Teaching awareness                                        | 0.99           | -0.81          | 0.25           | 0.5            |
| Teaching methods                                           | 0.92           | -0.56          | 0.33           | 0.5            |
| Teaching attitude                                          | 0.91           | -0.55          | 0.42           | 0.41           |
| Teaching level of specialized courses                      | 0.84           | -0.7           | 0.3            | 0.28           |
| Teacher feedback and assessment                            | 1.16           | -0.54          | 0.35           | 0.27           |
| The help provided by college teachers                      | 1.03           | -0.29          | 0.95           | 0.22           |
| The contact and communication between college teachers and guidance teachers of bedside teaching units | 1.11           | -0.31          | 1.02           | 0.22           |
| The effect of the college's supervision on bedside teaching sites | 1.07           | -0.33          | 1.01           | 0.13           |
| The students' report on bedside teaching                   | 1.11           | -0.24          | 0.93           | 0.46           |
| The degree of receiving college information                | 1.2            | -0.38          | 1              | 0.13           |
| The Value-added of overall satisfaction                    | 1.05           | -0.57          | 0.75           | 0.24           |

Questionnaire:
| First index               | Second index                          | Tertiary Index                                                                 |
|--------------------------|---------------------------------------|--------------------------------------------------------------------------------|
| Evaluation of teaching   | Teaching environment of the base       | Question 1. Satisfaction with teaching facilities and sites                     |
| base                     |                                       | Question 2. Satisfaction with clinical diseases                                |
|                          |                                       | Question 3. Satisfaction with learning opportunities                           |
|                          |                                       | Question 4. Satisfaction with student management                               |
|                          |                                       | Question 5. Satisfaction with base accommodation environment                  |
| Teacher's teaching       |                                       | Question 6. Satisfaction with teaching consciousness                           |
|                          |                                       | Question 7. Satisfaction with teaching methods                                  |
|                          |                                       | Question 8. Satisfaction with teaching attitude                                 |
|                          |                                       | Question 9. Satisfaction with the teaching level of professional courses        |
|                          |                                       | Question 10. Satisfaction with teachers' feedback and assessment                |
| Information feedback     |                                       | Question 11. Satisfaction with the help provided by college teachers            |
| system for teachers and  |                                       | Question 12. Satisfaction with the contact and communication between college    |
| students                 |                                       | teachers and the instructor of bedside teaching unit                           |
|                          |                                       | Question 13. Satisfaction with the effect of the college's supervision on      |
|                          |                                       | bedside teaching sites                                                         |
|                          |                                       | Question 14. Satisfaction with the students' report on bedside teaching         |
|                          |                                       | Question 15. Satisfaction with the patency of receiving college information     |
| Student self-Evaluation  | Student's own ability                 | Question 16. Satisfaction with professional theory level                        |
|                          |                                       | Question 17. Satisfaction with professional operation skills                   |
|                          |                                       | Question 18. Satisfaction with doctor-patient communication skills             |
|                          |                                       | Question 19. Satisfaction with self-professional identity                      |

Student satisfaction survey of bedside teaching base of the second clinical medicine school of Zhejiang Chinese Medicine University

**Discussion**
3.1 Analysis of the relationship between bedside teaching base and academic development of medical students

Bedside teaching, as an important teaching method in modern medical education, has important significance in training medical students' theoretical knowledge and practical ability, cultivating clinical medical students' scientific and comprehensive clinical thinking, and improving medical students' quality [6]. Jed D Gonzalo, who implemented a value-added clinical system's learning role for medical students, found that the educational benefits students gained from it span multiple areas of learning that are consistent with clinical and health system science and can transform learning from a doctor-centered to a patient-centered approach [7]. Research shows that the application of "student-centered" bedside teaching mode is of great benefit to the cultivation of critical thinking of medical students, which is more in line with the current needs [8-10]. The Novel Corona virus pandemic has had a significant impact on global medical education and bedside instruction is being replaced by various online educational models [11]. Therefore, it is urgent to strengthen the construction of clinical teaching base and carry out reform and innovation in medical colleges and universities, while the application of TVAAS makes a reasonable analysis of innovative bedside teaching results [12].

This study analyzed the teaching situation of each clinical teaching base through the Tennessee Value-added Assessment System, and found that, compared with 2015, the academic performance of 2016 grade students was improved after receiving teaching, indicating that the reform of bedside teaching mode was correlated to the academic progress of students to some extent.

3.2 Analysis of students' satisfaction with various indicators of bedside teaching base

According to the research data, compared with the grade of 2015, the satisfaction degree of students of grade 2016 on various indicators of bedside teaching bases has been improved, and the heterogeneity of various indicators of various clinical teaching bases has also been clearly reflected. Through TVAAS, managers of schools and colleges can clearly see the advantages and disadvantages of each clinical teaching base, so as to carry out educational reform and promote the all-round development of students. It is only in accordance with the teaching needs of students that makes teaching management in clinical bases give full play to students' strengths, take into account the development and progress of all students, and mobilize students' learning enthusiasm.

3.3 Suggestions on ways to improve the teaching quality evaluation management in clinical teaching base

3.3.1 Take Tennessee value-added assessment system as the basis point and attach importance to the principal role of students

TVAAS urges us to re-examine traditional higher education and pay attention to the core role of students' personal development and learning in the quality of higher education. Based on the "student participation" theory proposed by Austin in 1985, students can learn better only if they actively participate in various
activities in the university. Student learning is the whole process of student participation, and the important measure to measure the quality of university education is whether it can effectively promote the degree of student participation\textsuperscript{[13]}. Therefore, we should gradually pay attention to the teaching concept of "student-centered" and let students participate in the teaching reform in all aspects.

3.3.2 Establish value-added evaluation index of Tennessee, construct educational quality evaluation system

In Britain, there are three main indicators in the official school assessment system published by the government: the rate at which students miss school, the rate at which they pass their final exams and the value-added index of schools. The education authorities of these three indicators can take their own requirements according to the needs of evaluation\textsuperscript{[14]}. Compared with our current school evaluation index system, one of the main problems is the simplification of evaluation index, and the lack of effective evaluation of education and teaching process and student growth\textsuperscript{[15]}. In addition, the function and value of a school is not only to improve students' cognitive level and academic achievement, but also to include multidimensional goals such as emotions, attitudes and values. Therefore, it is far from enough to use a single student achievement index to measure school effectiveness. Some scholars have tried to use a variety of indicators, such as students’ dropout rate, transfer rate and students' emotional attitude measurement, to enrich and improve the school effectiveness evaluation system\textsuperscript{[16]}. Consequently, the establishment of school value-added evaluation index has a good reference value to improve the school evaluation system in China.

3.3.3 Promote school teaching mode reform guided by TVAAS

For universities, value-added evaluation can enable universities to know more about the "incremental" changes in students' academic performance, students' growth and development, so as to carry out teaching reform, explore its relevance to the improvement in school teaching quality, and promote the characteristic development of schools.

Conclusion

Tennessee Value-added Assessment System (TVAAS), as a new evaluation method, focuses on the study and growth of students, the process increment, and forms transverse and longitudinal detailed data, which can provide multidimensional information about higher education practitioners and thus serve for the reform and innovation of higher medical education. Therefore, higher medical colleges and universities should construct teaching quality evaluation management system based on TVAAS, and carry out "incremental" analysis of multi-dimensional indicators.

Declarations

Ethics approval and consent to participate
This research followed the tenets of the Declaration of Helsinki, written informed consent was obtained from all the subjects after explanation of the nature and possible consequences of the study. This study was approved by the ethics committee of the Second Affiliated Hospital of Zhejiang University of Chinese Medicine.

Consent for publication

Not applicable

Availability of data and material

All data generated or analysed during this study are included in this published article.

Competing interests

There is no potential conflict of interest relevant to this article.

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Authors contributions

Jiang Qingyu responsible for material collection, data sorting and text writing.

Wu Yuxi the implementor of the project, essay director.

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None

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Statements

All data generated or analysed during this study are included in this published article [and its supplementary information files].
All methods were carried out in accordance with relevant guidelines and regulations.

All experimental protocols were approved by a named institutional and/or licensing committee.

Informed consent was obtained from all subjects involved in this study.

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