

# Reduction in X-ray Retake Rate Using the Token Economy Method

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**Abstract.** Excessive retakes of X-ray images increase labor and material costs, as well as result in excess radiation exposure for patients and a long waiting time. In this study, we evaluated the effectiveness of the token economy method as a management method for reducing X-ray retake rate among radiology technicians. The results showed a 2.5% reduction in retake rate, indicating the effectiveness of our method. In addition, we suggest that the token-economy-based approach can be applied to other hospital management problems.

**Keywords.** Hospital Management, Token Economy, X-ray retakes

## 1. Introduction

Radiology technicians sometimes fail to obtain satisfactory radiographs; therefore, retakes are unavoidable. However, excessive retakes increase labor and material costs, as well as result in excess radiation exposure for patients and a long waiting time. Hence, department managers should reduce the retake rate while maintaining image quality. In this study, we implemented and evaluated the token economy method [1] to modify technicians' behavior so that more attention is paid to obtaining a satisfactory image at once.

## 2. Method

First, we designed a token economy to achieve the aforementioned goals. Specifically, we distributed 200 units of token at the beginning of the intervention, and technicians received 11 units of tokens when they successfully submitted the radiographic image, whereas they had to pay 10 units when they took them. We set these units based on the target retake rate of 10%. Next, to evaluate our method, we compared the retake rates of the two periods before implementing the token economy (1<sup>st</sup> phase: no specific intervention, 2<sup>nd</sup> phase: individual retake rates were pinned up for mutual comparison), and periods after implementing the token economy. In this study, we limited the target to skeleton radiography imaging, which requires technicians' skill; therefore, retake rates

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should be manipulated with their effort. We recruited seven technicians from a university hospital in Japan and calculated the retake rates among these phases. This study was approved by the Kyoto University Hospital Ethics Committee (approval number: R3525)

### 3. Results

The retake rates for the study participants were  $10.7 \pm 3.6\%$  (mean  $\pm$  standard deviation [SD]),  $8.1 \pm 1.7\%$ ,  $5.6 \pm 1.4\%$  at the no-intervention, pinned-up, and token economy phases, respectively. Changes in the individual retake rates are presented in Table 1. Participants eventually accumulated 530–1140 units after 91 working days in the intervention period. To describe the accumulation process, for example, a participant initially loses 105 units of token but the participant's retake rate subsequently declines and they finally accumulate 909 units of token.

**Table 1.** Average retake rate for each period

Staff	A	B	C	D	E	F	G	Mean (SD)
No intervention	8.1	13.6	10.7	6.9	12.8	16.1	7.0	10.7 (3.6)
Pinned retake rates	6.6	9.1	10.3	5.7	8.7	9.5	6.8	8.1 (1.7)
Token economy	5.8	5.9	7.0	2.7	6.9	5.8	5.0	5.6 (1.4)

### 4. Discussion

Visualizing the number of available resources and self-management of consumed resources are hypothesized to lead to behavioral change among healthcare professionals [2]. Token economy is a visualization method based on a learning theory called operant conditioning. This behavioral psychological method transforms extrinsic motivation into intrinsic motivation [3]. As an application of behaviorist psychology, the current study was conducted to test management techniques in a clinical setting, based on changes in retake rates and token circulation. The results showed that the retake rate decreased for all staff members after the token economy intervention; on average, a 2.5% reduction in retake rate was observed in all staff in the token economy period compared to the “pinned” period. In addition, some participants showed improved retake rate after checking token reduction in their “wallets”. The retake rate for all staff members fell below the organization's target of 10%. These results indicate that the effectiveness of the proposed method at reducing the retake rate. In addition, we suggest that the token-economy-based approach can be applied to other hospital management problems.

### References

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