A System Dynamics Approach to the Hospital Nurse Turnover Problem in Taiwan

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ABSTRACT

The average nurse turnover rate in Taiwan's hospitals was 31.56% in 1988. High turnover rate has a detrimental effect on costs, staff morale, and patient care. Nursing staff turnover is a critical personnel problem for nursing administrators and top hospital management. In order to understand the underlying dynamic structure which causes such a high turnover rate of hospital nurses in Taiwan, we developed a system dynamics model. The results of computer simulation showed that the key solution to the hospital nurse turnover problem is not a quick-fix, but rather a long-term committed and supportive hospital administration to make improving in the nursing working conditions.

INTRODUCTION

In Taiwan, the average rates of nursing turnover in hospitals were 17.74% in 1983, 12.34-17.74 in 1985, and 31.56% in 1988; 89% of 81 hospitals existed with nursing shortages in 1989. The supply of nurses were enough for hospitals to employ, but nurses did not like to join hospitals. Nurses in hospitals complained of irregular working hours, unreasonable salaries, inadequate benefits, heavy workload, and poor promotional opportunities. Since high turnover rates and nursing vacancies had a detrimental effect on costs, revenues, staff morale, and patient care, administrators in hospitals improved working conditions for nurses. Turnover rates have declined in recent years, but newspapers reported the shortfall still were 14000 in 1993 (Shiau, Rong, Sheen, Yang, and Lan 1994; Hwang 1993; Chen, (Yu) Chao, Chiang, Chen, and Chang 1992; Yang 1992; Chang, (Yu) Chao, Yang, and Chou 1987).

Hospital working conditions for nurses are frequently less attractive than those in other areas of nursing practice and other professions. The shortage of registered nurses continues nationwide. Periodically it is announced that this has become an acute crisis (Helmer and McKnight 1988). Numerous studies have examined the reasons why staff leave their jobs, but these have often produced conflicting findings and have frequently relied upon bivariate

correlation or multiple regression techniques. The availability of analytical techniques such as structural modelling provides an opportunity to examine several aspects of turnover behaviour simultaneously, and overcome some of the methodological difficulties encountered by prior research (Cavanagh and Coffin 1992).

Nursing staff turnover is a critical personnel problem for nursing administrators and top hospital management (Mann 1989). Registered nurse turnover is a chronic problem in health care (Wall 1988). So, the problem may be appropriate for a system dynamics approach. The purpose of this research is to try to understand the underlying dynamic structure which causes the problem and to propose suggestions.

MODEL DESCRIPTION

Sectors of the model

The model has three sectors: the patients sector, the nursing sector, and the management sector. Patients are the demanders of nursing care, and nurses are the suppliers of nursing care. Nurses leave hospitals due to irregular working hours, unreasonable salaries, inadequate benefits, heavy workload, and poor promotional opportunities. Since high turnover rates and nursing vacancies can have a detrimental effect on costs, revenues, staff morale, and patient care, administrators in hospitals have to improve working conditions for nurses.

Causal Diagram

The causal diagram of this model is shown in Figure 1. In the causal diagram, there are five feedback loops.

Loop 1 (turnover rate of hospital nurses---recruiting, selecting, and training of new nurses---workload of hospital nurses---turnover rate of hospital nurses) is a positive feedback loop. The recruiting, selecting, and training of new nurses increases when the turnover rate of hospital nurses grows, so that workload of hospital nurses rises. An increased workload for the nurses who remain hospital, which in turn makes the turnover rate of hospital nurses to grow further. Therefore, the turnover rate of hospital nurses becomes higher and higher in this positive feedback loop.

Loop 2 (turnover rate of hospital nurses---attractiveness of hospital to outer nurses---nursing shortages---workload of hospital nurses---turnover rate of hospital nurses) is a positive feedback loop. When turnover rate of hospital nurses increases, the attractiveness of hospital to outer nurses decreases. Hospital faces the problems not only of retention but also of recruitment of nurses, which makes the nursing shortages grows. Persistent nursing shortages of 20-25% mean an increased workload for the nurses who remain hospital, which in turn affects morale.

Eventually more nurses leave (Delamothe 1988). Therefore, the turnover rate of hospital nurses becomes higher and higher in this positive feedback loop.

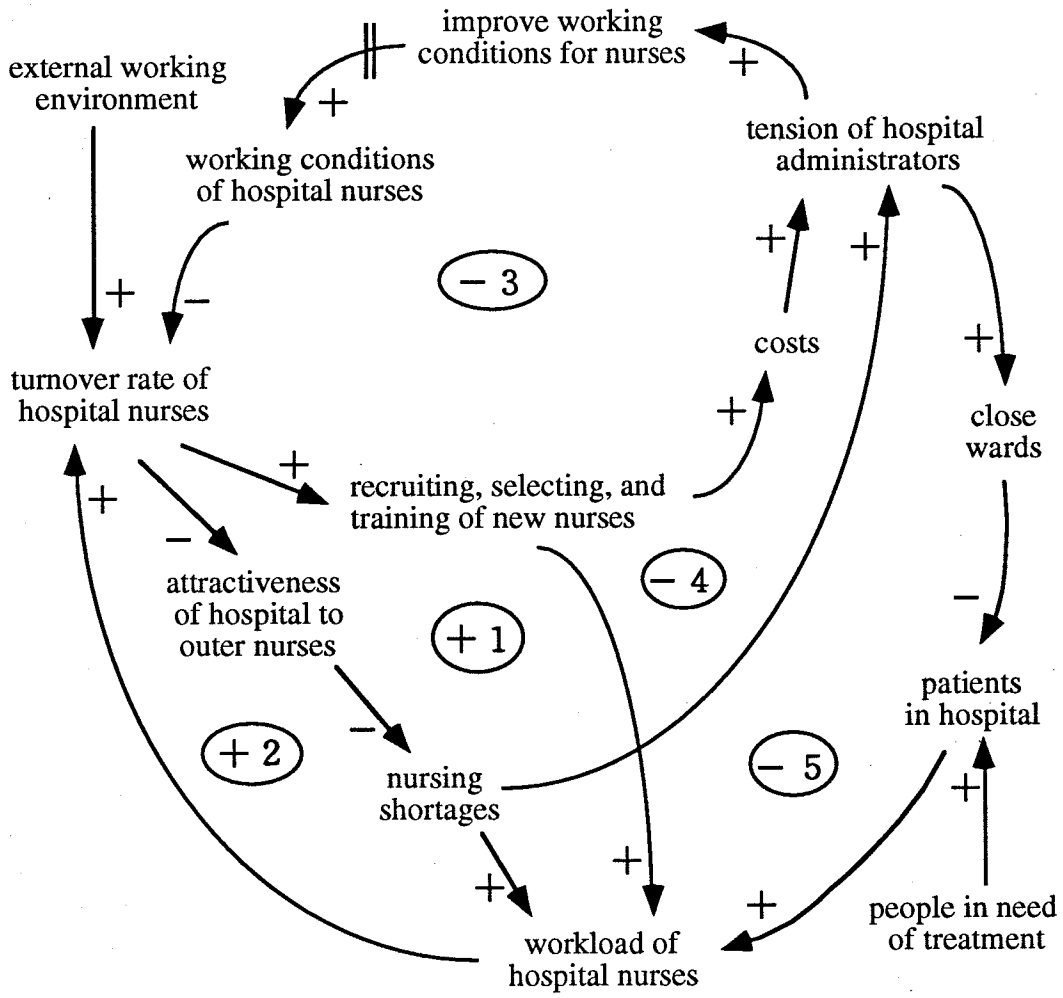

Figure 1. The causal diagram of the nursing turnover in hospital

Loop 3 (turnover rate of hospital nurses---recruiting, selecting, and training of new nurses---costs---tension of hospital administrators---improve working conditions for nurses---working conditions of hospital nurses---turnover rate of hospital nurses) is a negative feedback loop. When the turnover rate of hospital nurses grows, the recruiting, selecting, and training of new nurses increases. The costs of recruiting and orienting a professional nurse to an institution may range from $2000 to $5000 (Helmer and McKnight 1988; Wall 1988; Hinshaw, Smeltzer and Atwood 1987). When the recruiting, selecting, and training of new nurses rises, costs grow so that the tension of hospital administrators increases. When the tension of hospital administrators rises, the administrators then improve the working conditions for nurses, which makes the

working conditions of hospital nurses a change for the better. When the working conditions of hospital nurses are improved, the turnover rate of hospital nurses decreases.

Loop 4 (turnover rate of hospital nurses---attractiveness of hospital to outer nurses---nursing shortages---tension of hospital administrators---improve working conditions for nurses---working conditions of hospital nurses---turnover rate of hospital nurses) is a negative feedback loop. The attractiveness of hospital to outer nurses decreases when turnover rate of hospital nurses increases, so that the nursing shortages grows. Beds have to be shut down due to nursing shortages or loss of experienced staff, resulting in a loss of bed revenues (Mann 1989; Delamothe 1988). When the nursing shortages rises, the tension of hospital administrators increases, which makes the administrators improve working conditions for nurses. When the working conditions of hospital nurses are improved, the turnover rate of hospital nurses decreases.

Loop 5 (turnover rate of hospital nurses---attractiveness of hospital to outer nurses---nursing shortages---tension of hospital administrators---close wards---patients in hospital---workload of hospital nurses---turnover rate of hospital nurses) is a negative feedback loop. The attractiveness of hospital to outer nurses decreases when turnover rate of hospital nurses increases, so that the nursing shortages grows. When the nursing shortages rises, the tension of hospital administrators increases, which makes the administrators close wards. When the administrators close wards, patients in hospital decreases so that the workload of hospital nurses declines. When the workload of hospital nurses reduces, the turnover rate of hospital nurses decreases.

It is assumed that people in need of treatment and external working environment are exogenous variables.

Key variables and equations

Turnover rate determination function

Naturally, the extent of functional turnover (turnover that actually is beneficial to the organization) is unknown. Presumably, it would vary depending on the nature of the organization (Dalton and Krackhardt 1982). It is economically dysfunctional when it reduces the capacity of hospital units (Mann 1989). When workload and environment gap increases, the turnover rate rises. This model deduces the determination of turnover rate as follows:

TR = separation/NCN eq.1
NCN = EN+NN eq.2
separation = INT(EN*(MIN(1,(FENTR+DENTR)))) eq.3
EN(t) = EN(t - dt) + (US- separation) * dt eq.4
NN(t) = NN(t - dt) + (selection - US) * dt eq.5

DENTR = DELAY(EEGTR+EWTR,0.5) eq.6
EEGTR = GRAPH(EG)
(-0.05, 0.00), (-1.39e-18, 0.00), (0.05, 0.05), (0.1, 0.25), (0.15, 0.375), (0.2, 0.45), (0.25, 0.48), (0.3, 0.505), (0.35, 0.52), (0.4, 0.525), (0.45, 0.525) eq.7
EG = EWE-WC eq.8
EWE = 1*(1+GREWE)^(TIME-1981) eq.9
where
TR: turnover__rate(dimensionless)
NCN: number_of_current_nurses(persons)
EN: experienced_nurses(persons)
NN: new__nurses(persons)
separation(persons/year)
FENTR: functional_experienced_nursing_turnover_rate(dimensionless)
DENTR: dysfunctional_experienced_nursing_turnover_rate(dimensionless)
US: up_to_speed(persons/year)
dt: delta time, simulation solution interval(years)
EEGTR: effect_of_environment_gap_on_turnover rate(dimensionless)
EWTR: effect_of_workload_on_turnover rate(dimensionless)
selection(persons/year)
EG: environment_gap(dimensionless)
EWE: external_working_environment(dimensionless)
WC: working_conditions(dimensionless)
GREWE: growth_rate_of_external_working_environment(dimensionless)

Nursing shortage determination function

When turnover rate of hospital nurses increases, the attractiveness of hospital to outer nurses decreases. Hospital faces the problems not only of retention but also of recruitment of nurses, which makes the nursing shortages grows. This model deduces the determination of nursing shortage as follows:

NS = recruitment-selection eq.10
recruitment = NAN-NCN + separation eq.11
selection = MIN(recruitment,respondents) eq.12
respondents = recruitment*DELAY(AHON,0.5) eq.13
AHON = GRAPH(TR)
(0.2, 1.00), (0.23, 1.00), (0.26, 0.98), (0.29, 0.925), (0.32, 0.825), (0.35, 0.7), (0.38, 0.6), (0.41, 0.535), (0.44, 0.505), (0.47, 0.485), (0.5, 0.485) eq.14
where
NS: nursing_shortage(persons)
recruitment(persons)
NAN: number_of_authorized_Nurses(persons)
respondents(persons)
AHON: attractiveness_of_hospital__to_outer_nurses(dimensionless)

Tension of improving working conditions determination function

High turnover rate has a detrimental effect on costs, staff morale, and patient care. The turnover rate rises, then the tension of hospital administrators increases, which makes the administrators improve working conditions for nurses. When the working conditions of

hospital nurses are improved, the turnover rate of hospital nurses decreases, which in turn reduces the tension of improving working conditions. This model deduces the determination of tension of improving working conditions as follows:

TIWC(t) = TIWC(t - dt) + (IT - RT) * dt eq.15
IT = GRAPH(TR)
(0.2, 0.00), (0.22, 0.03), (0.24, 0.115), (0.26, 0.45), (0.28, 0.8), (0.3, 0.925), (0.32, 0.985), (0.34, 1.00), (0.36, 1.00), (0.38, 1.00), (0.4, 1.00) eq.16
RT = IF((RP=1)AND(TR<0.28))THEN(TIWC)ELSE(0.2*TIWC) eq.17
RP = DELAY(IF(TIWC>1)THEN(1)ELSE(0),1) eq.18
where
TIWC: Tension_of_improving_working_conditions(dimensionless)
IT: increasing_tension(dimensionless)
RT: tension_reduced(dimensionless)
RP: retention_policy(units)

Working conditions determination function

Administrators in many hospitals have not always been responsive to suggestions from nurses about ways to improve working conditions (Helmer and McKnight 1988). This model deduces the determination of working conditions as follows:

WC(t) = WC(t - dt) + (improving) * dt eq.19
improving = WC*IRWC eq.20
IRWC = IF(RP=1)THEN(GREWE+0.03)ELSE(GREWE-0.01) eq.21
where
improving(dimensionless)
IRWC: improving_rate_of_working_conditions(dimensionless)

SIMULATION

As shown in the causal diagram of Figure 1, if people in need of treatment and external working environment do not change, the feedback loops will remain steady and no fluctuation will occur. We will change people in need of treatment (PNT) in Test 1 and growth rate of external working environment (GREWE) in Test 2 to some extent and see the patterns of simulated outcomes. Time for simulation is 40 years.

Test 1

Suppose test 1 input conditions are as follows:

PNT = 480+PULSE(120,1987,100)

GREWE = 0

The PULSE function generates a pulse input. Figure 2 shows the system behavior under test 1 input conditions. In Figure 2, workload rises and declines sharply because people in need of treatment pulses. The rapid growth workload in turn increases quickly the turnover rate of

hospital nurses. Tension_of_improving_working_conditions increases sharply because turnover rate grows rapidly. When turnover rate rises, the attractiveness of hospital to outer nurses decreases (not shown). Hospital faces the problems not only of retention but also of recruitment of nurses, which makes the nursing shortages ascends. Workload increases again due to high turnover rate and nursing shortages, which in turn grows turnover rate again. Tension_of_improving_working_conditions decreases due to the rate of tension reduced greater than the rate of increasing tension (not shown). Turnover rate rises again results in the rate of increasing tension greater than the rate of tension reduced (not shown), which makes tension_of_improving_working_conditions ascends again.

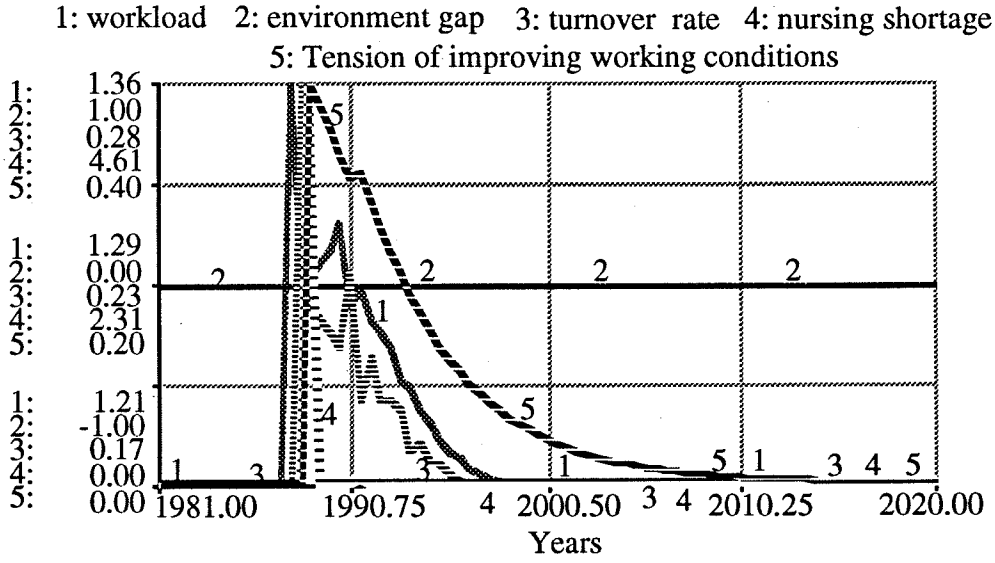

Figure 2. System response under the test 1 input conditions

Test 2

Suppose test 2 input conditions are as follows:

PNT = 480

GREWE = 0.05

Figure 3 shows the model response to test 2 input conditions. In Figure 3, environment gap rises because external working environment grows by a constant 5 percent per year. The increased environment gap in turn ascends the turnover rate of hospital nurses. The recruitment and selection of new nurses rises (not shown) when the turnover rate of hospital nurses grows, so that workload of hospital nurses increases. When the turnover rate rises, the tension of hospital administrators increases, which makes the administrators improve working conditions for nurses. When turnover rate rises, the attractiveness of hospital to outer nurses decreases (not shown). Hospital faces the problems not only of retention but also of recruitment of

by 90 from 1995.

PNT = 480+STEP(90,1995)

Following the STEP change, the results indicated in Figure 5 still show fewer fluctuations than the behavior resulting from the original system (as in Figure 3).

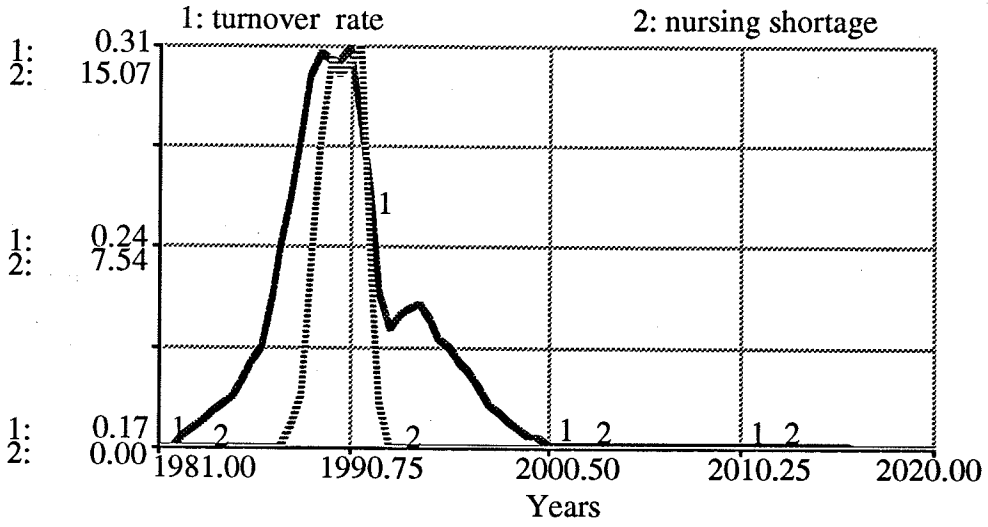

Figure 4. System response under the conditions of PNT = 480, GREWE = 0.05, and new policy from 1992

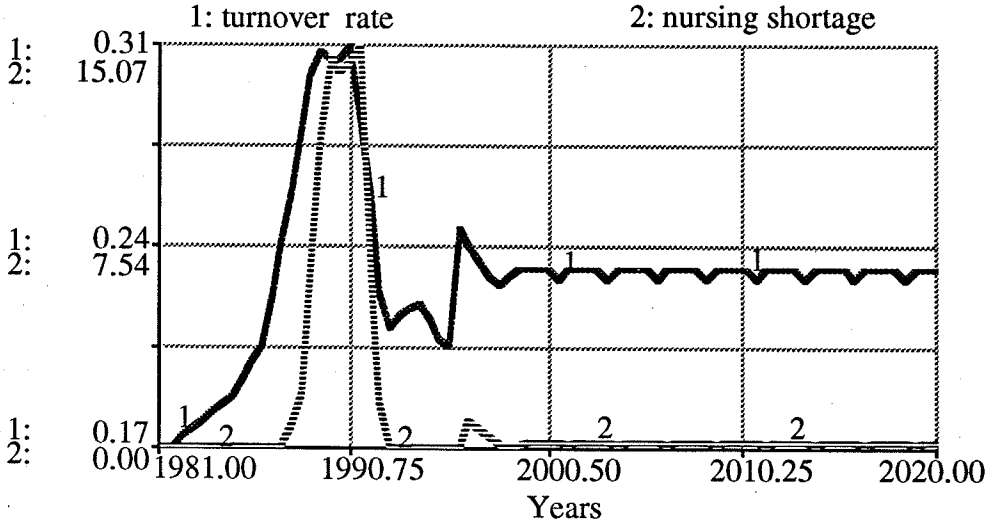

Figure 5. System response under the conditions of PNT = 480+STEP(90,1995), GREWE = 0.05, and new policy from 1992

SUMMARY

The problem of turnover rate fluctuations of hospital nurses has been examined and the dynamic structure of information and decision flows causing that problem has been described. In the model, the structure has been changed and tested. Hospital nurse turnover problem appears to have been eliminated in the new structure.

One general conclusion that may be drawn from this study, however, is that fluctuations are often not externally caused but are internally generated. Hospital administrators and directors of nursing used to blame outside forces for the nursing turnover problem in Taiwan. The results of computer simulation based on a system dynamics model show the key solution to the hospital nurse turnover problem is not a quick-fix, but rather a long-term committed and supportive hospital administration to make improving in the nursing working conditions.

Our proposed suggestion to the complex problem of turnover seem very straightforward. Perhaps the greatest obstacle to implementing this suggestion is that hospital administrators, just like many other major institutions in our society, and many other societies in the world as well, have to undergo a paradigm shift in management attitudes and practices.

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nurses, which makes the nursing shortages grow. The environment gap declines when the working conditions of hospital nurses are improved, so that turnover rate of hospital nurses decreases.

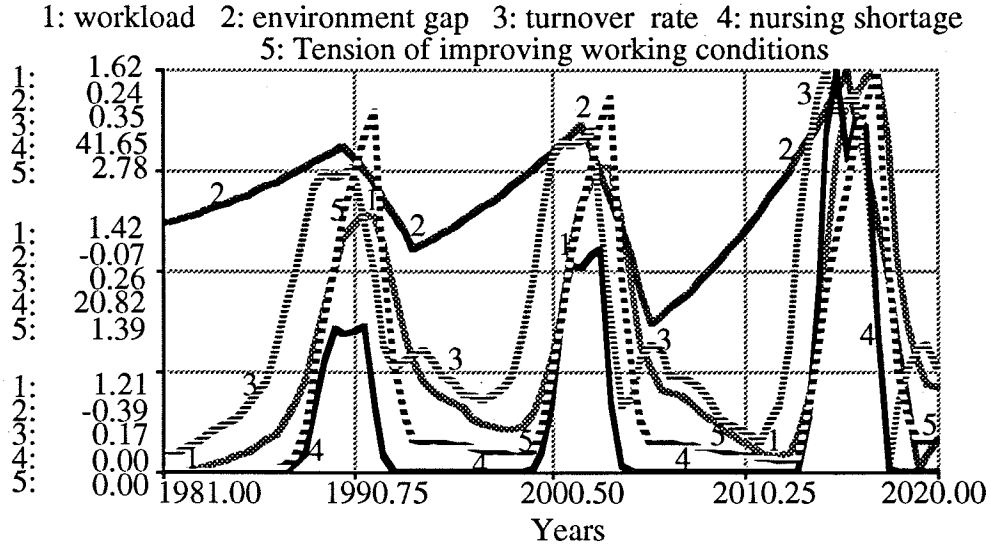

Figure 3. System response under the test 2 input conditions

Policy design for improving behavior

The problems are manifested as undesirable oscillations in the behavior of the system. This situation may be improved by changing policies used by management. The new policy results described below are derived through analysis and trial of various policies. Although only the final results are presented here, the process to obtain these is long and far from simple.

Instead of responding to turnover rate in making decisions about improving working conditions for nurses, management should improve working conditions for nurses actively. The former eq.21 is modified:

IRWC = IF(RP=1)THEN(GREWE+0.03)ELSE(IF(TIME<1992)THEN(GREWE-0.01)ELSE(GREWE+0.001))

The results indicated in Figure 4 show fewer fluctuations than the behavior resulting from the original system (as in Figure 3). Turnover rate has a peak value in Figure 4 of 0.31 in 1988 and gradually returns to its normal value of 0.17 without much oscillation.

Testing scenarios in policy design

Hospitals experience many other types of external environment changes. A good policy cannot be chosen until policy performance is evaluated under the conditions the hospital is likely to face. If the people in need of treatment remains steady in 1981-1994, it then increases