DYNAMIC IMPACTS OF PERFORMANCE BASED PAYMENT SYSTEM ON PUBLIC HOSPITALS IN TURKEY

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Abstract

The goal of pay for performance (P4P) system in healthcare is to increase the efficiency of healthcare resources by paying physicians and hospitals for performance. Ministry of Health in Turkey has implemented P4P since 2004. The purpose of this study is to investigate the dynamic impacts of P4P on the behaviors of hospitals and physicians. The model includes physicians' interactions with patients, the revenue pressures on physicians, and the resulting impacts on health outputs and quality. In order to increase productivity, physicians are induced to perform more medical activities. Physician, who experiences revenue pressure, may try to increase his/her revenue by performing more medical activities and give less importance to quality. Resulting inadequate treatments and wrong diagnosed patients would have negative effects on health quality. On the other hand, physicians who do not have any revenue concerns may give the quality of healthcare absolute priority, undermining the productivity. This tendency may result in hospital crowding and high crowding pressures on physicians. Such conflicting pressures are included in model to investigate the impacts of P4P on health outputs in public hospitals. Results obtained concur with our dynamic hypotheses and agree with some of the general behaviors recently observed in Turkish healthcare.

Key words: Pay for performance (P4P), performance based payment system, health quality, system dynamics, health modeling.

1. INTRODUCTION

The main goals of health system are to protect people's health, to treat them if they need any medical support and to provide better life quality. According to the OECD health statistics, average annual growth rate in total health expenditure per capita was 4.8 % in US between 2003 and 2009. Moreover, average growth rate in total health expenditure was 4 % in US between 2003 and 2009 [4]. Despite the amount of money spent on healthcare, the performance of healthcare is lower than expected. Developed and developing countries still have to confront chronic and unsolvable problems in healthcare. Rising share of health expenditure in GDP; long waiting times for examination, inaccessibility and disparities in healthcare and deaths due to incorrect diagnoses and medical operations draw attention to the efficiency in healthcare. Developed and developing countries investigate new solutions for decreasing the costs of health meanwhile improving the healthcare quality. Consequently, they try to implement new policies and programs for solving healthcare problems.

One of the most recently applied policies in healthcare is pay for performance (P4P) or performance based payment system (PBPS). P4P is a common method of medical payment system, incorporating additional payments with output and/or quality improvement. P4P

system's aim is to increase the efficiency of healthcare resources by paying salary bonus for increased performance. Healthcare providers usually achieve incentives for improvements in process measures or in outcome measures. Outcome measure is the result of patient care whereas process measure is the care that is provided [5].

Selecting process measures or outcome measures is a controversial issue. There are advantages and disadvantages for each of these options. Process measures are easy to control and accessible to obtain adequate information. Conversely, outcomes depend not only on physician effort, but also on other factors beyond the control of medical professional such as socio-economic background and environmental factors. Process measures can be defined as time spent per examination, number of medical operations performed, number of drugs used by patient. Outcomes can be defined as the percentage of permanent recovery, complications due to wrong medical operations, the number of inadequate treatments etc. In order to gain success in outcome measures, structural improvements and process improvements are needed. In general, process measures and outcome measures are combined to get better results from monitoring the health system, providing better health care quality, and efficient utilization of health resources [5].

The problems in developing countries are more structural in nature as opposed to process problems. What is meant by structural problems are organizational problems, lack of adequate supply and high demand in healthcare, laws and policies bringing about disparities and chronic problems in healthcare. For instance, prior to 2003, Turkish Health System was characterized by the presence of several different public agencies funding and providing healthcare, some vertically integrated and others relying on contractual relationships [6]. These agencies served different parts of population in different hospitals and different health centers. Therefore, accessibility problems and disparities in healthcare might partially have resulted from the structure of health organization itself in Turkey.

According to OECD report "Turkish Health Performance Determinants" in 2006, physician per 1000 capita is 1.6 in Turkey whereas the OECD average for physician per 1000 capita is 3.6. Taking developing and developed country examples, it can be easily seen that insufficiency in the number of physicians is a serious problem for Turkish Health system. The average number of graduated physician rate for 1000 capita in Turkey is 4% per year in 2006, whereas the OECD average is 3% per year. However; increase in birth rate and aging population make physician graduation rate inadequate to meet the health demand. Unfortunately, unlike developed countries, physicians may examine approximately 100 patients a day in Turkey and spend approximately four to nine minutes per examination to meet the health demand. This tendency may result in inadequate treatments, possible readmissions to hospitals and increase in hospital visits per year. As a result, government decided to meet the health demand by increasing the productivity of health resources. Long waiting lines, waiting times, inaccessibility to consultation, disparities in healthcare motivated the ministry of health (MOH) to implement new health program: Health Transition Program (HTP). Thus, government has initiated HTP in 2003. Government's aim was to make the health system more effective and efficient by improving user and provider satisfaction and long term financial sustainability [7].

One of the reforms that government implemented as a part of HTP is PBPS. Basically, the system awards physicians who perform more medical operations compared to the average physician performance. The aim of this program is to increase the productivity of health centers and physicians for meeting growing health demand.

PBPS was first implemented in pilot centers in 2003. Then, the program was extended to cover first step public hospitals throughout the country. There were two phases of this program. One-year implementation of PBPS in 2004 provided the participation of health employees and health centers. Moreover, the implementation provided required infrastructure for enabling the performance measurement of health centers and employees. Some quality measures were tried and implemented throughout the country in 2005. Corporate performance measurement was included in this program by the ministry of health in 2007[10].

PBPS has been in practice since 2004. This system has been applied in *first, second and third step* public health centers, except university hospitals. This classification was made by the ministry of health (MOH) in 2003[11]. First step public health centers are small health centers such as infant health centers, village clinics and family planning centers etc. Second step public health centers have more capability for providing more complex and complete health service. Second step public health centers are public hospitals, social insurance institution hospitals and other state hospitals. Third step public health centers are education and research hospitals and university hospitals. Since February 2011, PBPS has been implemented in university hospitals.

PBPS is used for determining how much additional payments physicians take due to their performance. The additional payments of physicians are basically dependent on the number of examinations, diagnostic tests and medical operations they perform. These payments are made from the hospital's revolving budget. Depending on hospital's financial performance, hospitals can allocate more money to their employees. Financial performance is highly dependent on the revenue of hospitals. Therefore; if a hospital earns more money by performing value added medical operations, it can pay employees more reimbursements from revolving budget. As a result, hospitals may induce physicians to perform more examination and medical operations in order to increase their revenue.

2. PROBLEM IDENTIFICATION AND DATA ANALYSIS

PBPS has been implemented in second and third step public health centers, except university hospitals since 2004. When resource utilization increased in first and in second step public health centers, government decided to implement PBPS in university hospitals in 2011.

The purpose of this study is to investigate the effects of PBPS on the performance of *second step public hospitals*. These effects can be separated into three parts: the effects on treatment quality, the effects on health costs and the effects on health productivity.

In order to understand the effect of PBPS on treatment quality, it is necessary to characterize the health quality. While defining the health quality, it is important to take health system as a whole and to have a whole-system perspective [12].

According to the Institute of Medicine, health quality consists of the "degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge." [12].

According to the WHO Health Report 2006, health quality has 6 dimensions. These dimensions are important to understand the scope of the health definition [12]. Health quality dimensions are effectiveness, efficiency, accessibility, acceptable / patient-centered, equity and safety.

Health policy makers should keep in mind to construct measurable quality variables to fulfill basic health dimensions above. These variables can be waiting times for medical treatment; time spent per examinations, treatment percentage, unit cost of medical activities and health expenditure due to the health quality outcomes. Moreover, the effect of physician's revenue, health system construction, health crowding and interactions within these variables should be taken into account for achieving desired health quality.

With respect to the health quality definitions and dimensions and variables, PBPS should be analyzed in order to investigate the effect of the system on these variables and interaction within health sub-systems in Turkey.

PBPS implementation in Turkey considers public health centers as revenue generating places. The aim of health ministry is to increase the productivity, quality and efficiency in healthcare. However these goals may contradict with each other in some ways.

With the high importance of revenue concerns of hospitals and health employees, healthcare quality may decline to second priority. Unnecessary medical operations and examinations may be performed in order to increase hospital's revenue. Examination crowding in hospitals may increase to a point where health resources cannot meet. And the gap between capacity and health demand, which is also the main problem and the main motivation of Turkish Health System, may widen. One other result may be increases in health expenditures which would affect the continuity of PBPS implementations. While hospital resources have been used more efficiently since PBPS, health care expenditures have also increased due to rising prescriptions, surgery, medical operations and examinations [7].

The following graph represents the changes in physicians' revenue after PBPS. As it can be seen from below; by excluding the inflation effects, physicians can increase their revenue by performing more medical activities in first two years. Fluctuations in inflation rates reduce the growing pattern of physician revenue in real values. These values are obtained from Turkish Health Statistic Yearbook 2011.

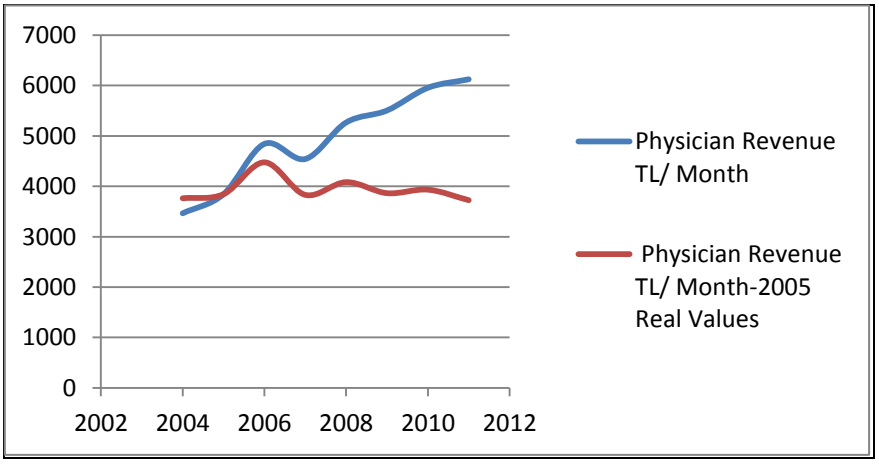

Figure 1: Physicians' Revenue per month.

Treatment, rather than examination or surgery is an important factor for health service quality. One way to measure treatment in healthcare is the percentage of permanent treatment of treatable patients. PBPS may induce physicians to perform more examinations and surgeries rather than treat patients permanently. The other way for measuring the treatment

quality is time spent per examination. With the effect of revenue concerns of hospitals and physicians; physicians may spend less time on examination, give less attention to patients' complaints, diagnose quickly and prescribe unnecessary medicines. Time spent per examination in Turkey, which is very important for the correct diagnosis and permanent treatment of patients, changes between four minutes to nine minutes. Time spent per examination in Turkey is far lower than the OECD average. In order to increase health service quality, time spent per examination should increase. However; with the implementation of PBPS, time spent per examination may decrease. Reduction of time spent per examination may be the reason of incorrect or incomplete diagnosis, unnecessary tests / analysis and inadequate treatments. Because of the revenue concerns, numbers of medical activities performed per year have increased since PBPS. The following graph shows number of surgeries performed per year after PBPS implementation in healthcare. It can be interpreted that there has been continuous increase in number of surgeries performed between 2005 and 2009.

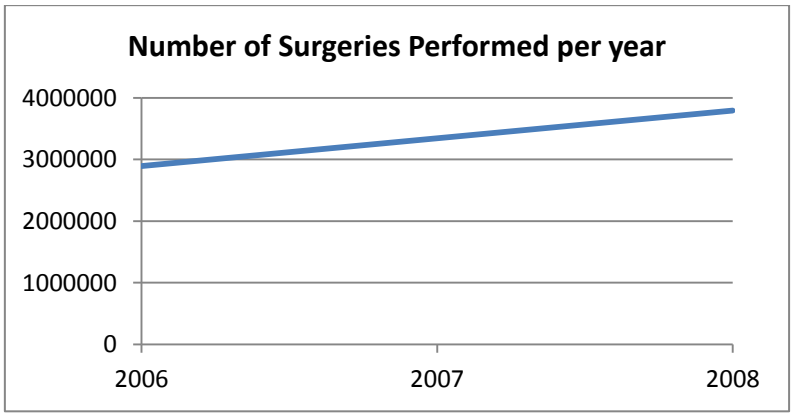

Figure 2: Number of Surgeries Performed per year.

However, increases in medical activities do not reflect increases in health quality indicators. As mentioned before, there may be a negative relationship between health quality and health productivity. Low health quality and inadequate treatments may result from more admissions to ministry of health hospitals. This can be a reason for growing trend in Figure 3.

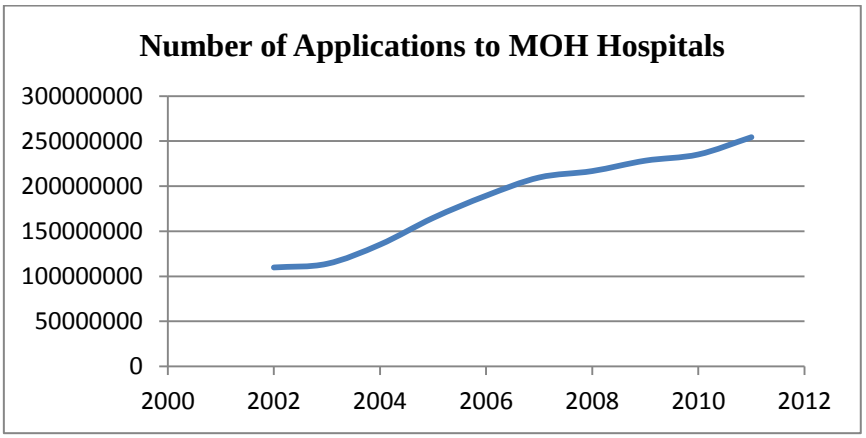

Figure 3: Number of Applications to MOH Hospitals.

System dynamics method is selected for understanding the dynamics of public hospitals under PBPS. The base model will represent the dynamic impacts of the currently implemented PBPS on second step public hospitals.

3. MODEL DESCRIPTION

Dynamic simulation model includes patients, physicians, physician's medical activities and performance calculation related variables. System dynamics methodology is used in constructing the model. The motivation of this modeling study is to examine dynamic impacts of PBPS on health outputs and quality.

In general, the main variables are patient flow related variables in hospital, salary related variables for physicians, and revenue related variables for hospitals. Revenue related variables are a representation of the simplified version of the complex PBPS.

For investigating patient flows in hospitals: correct diagnose rate, wrong diagnose rate, correct treatment rate, wrong treatment rate, inadequately treated patients, surgical correction rate and patients applying for treatment to another hospital are taken into account for building a base stock-flow diagram that represents second step public hospital reactions to PBPS.

There are four main stocks in model: treatable patients with diagnostic, treatable patients, inadequate treatments, chronic patients and inadequate surgeries. Treatable patients with diagnostic represents patients who apply for medical treatment to hospital and wait for diagnose of their health problems. Treatable patients are patients who pass diagnose process and wait for treatment. What is meant by treatment is the treatment of special patients such as diabetes, asthma and cancer patients. Treatment of these special patients is to resolve the patient complaints and provide acceptable live standards and the continuity of healthcare.

Other important stock variables are inadequate treatments and inadequate surgeries. These variables are the result of wrong diagnoses and treatments flows and affected by various effects of time spent per examination and tests by directly or indirectly.

The main variables which affect the stocks and dynamics of the model are time spent per examinations, number of physicians (health employee resources), hospital bed capacity, unit performance points.

Number of patients inadequately treated is the result of inadequate treatments and affected by time spent per examination, number of patients examined per month. Treatable patients with diagnostic represents patients whose diagnoses are not complete and need medical examinations and tests more than regular patients, visit hospital and apply for treatment more than average per month.

Considering the types of medical operations performed, number of doctors in hospital is divided into three parts in SD model: surgeon physicians, specialist physicians and diagnostic physicians. Apart from specialist physicians, surgeon physicians also perform surgery and can get additional payments due to the number of surgery performed per month. Diagnostic physicians are responsible for performing tests and aiding physicians to diagnose correctly with supplying test results.

Salary calculations for specialist physicians and surgeon physicians are pretty much same except surgery payments to surgeons. For each month, physicians and surgeons examine patients, perform medical operations, make hospital visits and get additional payments due to their medical activities. If a physician performs more medical operations, then PBPS awards him/her with more additional payments. Diagnostic physicians obtain

performance points respect to the number of tests that they perform. Salary calculations are based on performance point calculation for month and simplified version of current PBPS.

Another important variable for PBPS is the revenue of hospital. Additional payments from revolving budget are strictly related to the hospital's revenue. As a result, hospitals may induce physicians and surgeons for performing more examination and medical operations for increasing hospitals' income. Moreover, physicians may tend to refer more patients to hospital care and to increase patients' length of stay in hospital to increase the revenue of hospital. Furthermore, surgeons may refer patients to surgery care for revenue purposes, even if patients' condition is not severe enough for surgery care. In addition to medical operations; tests and analysis, which are performed in hospitals, increase hospital revenue.

Causal loop diagram of the model can be seen below. This diagram is simplified representation of main loops of model structure. Loop's polarity, the relationships between variables are shown in Figure 4.

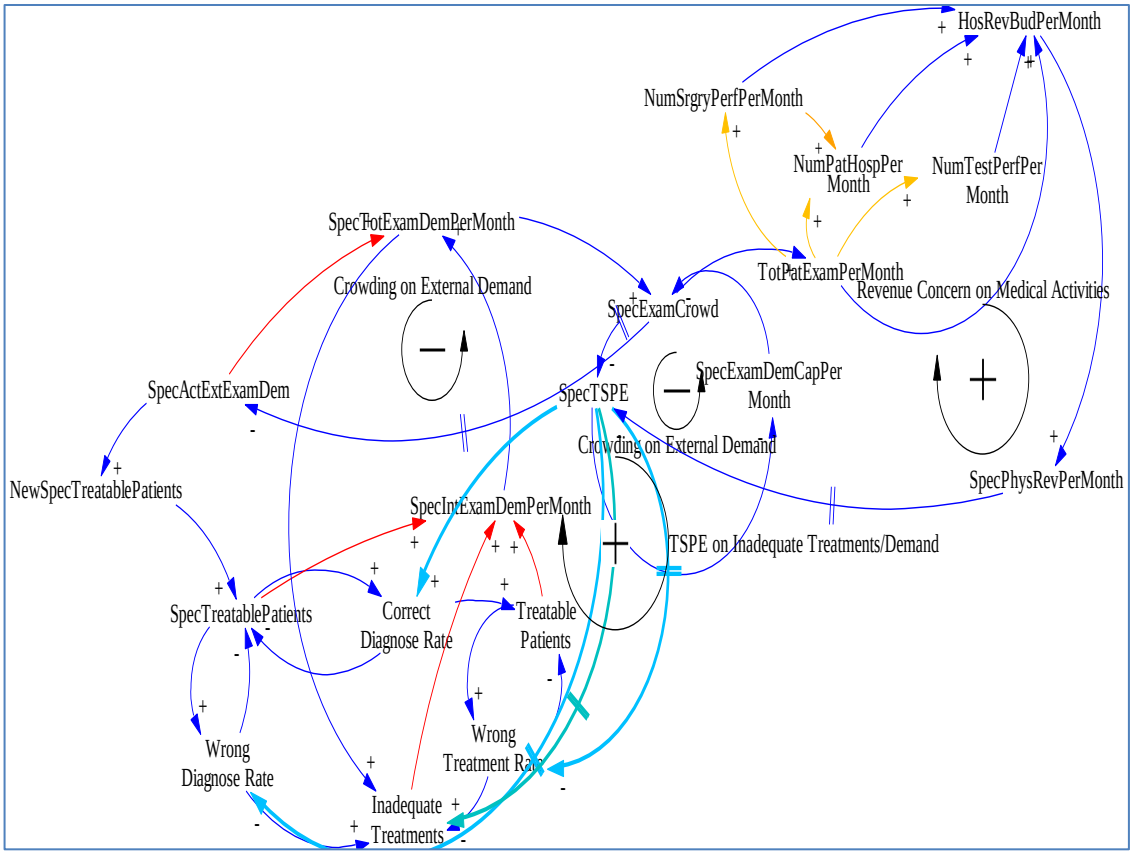

Figure 4: Causal-Loop Diagram.

In order to examine the dynamic impacts of PBPS on health systems, a second step public hospital is modeled. The initial conditions, the number of physicians and physician reference revenue values are the average of second step public hospital in Istanbul.

Time horizon should extend far enough back in history to show how the problem emerged and describe its symptoms. It should extend also far enough into to the future to capture delayed and indirect effect of potential changes [15].

The problem/purpose of this study is the potential adverse effects of PBPS on second step public hospitals. Time horizon for base model should be long enough to understand the effects of PBPS. As a part of HTP, PBPS has been active since 2004.

Since, PBPS is generally based on the calculation of medical activities per month and a long term perspective is adopted, time unit of the problem was selected as month. In order to capture real system behavior and problem dynamics, time horizon was selected as 48 months. Time step (dt) analysis is done and time step is chosen as 1/8 month.

The model has three treatment structures: specialist physician patient's treatment structure, surgeon physician patient's treatment structure and re-surgical treatment of inadequate surgeries. The reason behind the diversity of physician patient's treatment structure is differences in performance point calculations of specialist and surgeons. Surgeons can gain surgery points by performing surgeries. Inadequate surgeries stock variable is also included in model to show dynamic behaviors of surgical treatment rate and its feedback effects on the system.

Interactions between revenue variables and quality variables are included in model. Physicians' revenue concern affects TSPE. With spending less time on examinations, physicians can increase their productivity and as a result their performance revenue. Simplified stock model is presented below in Figure 5.

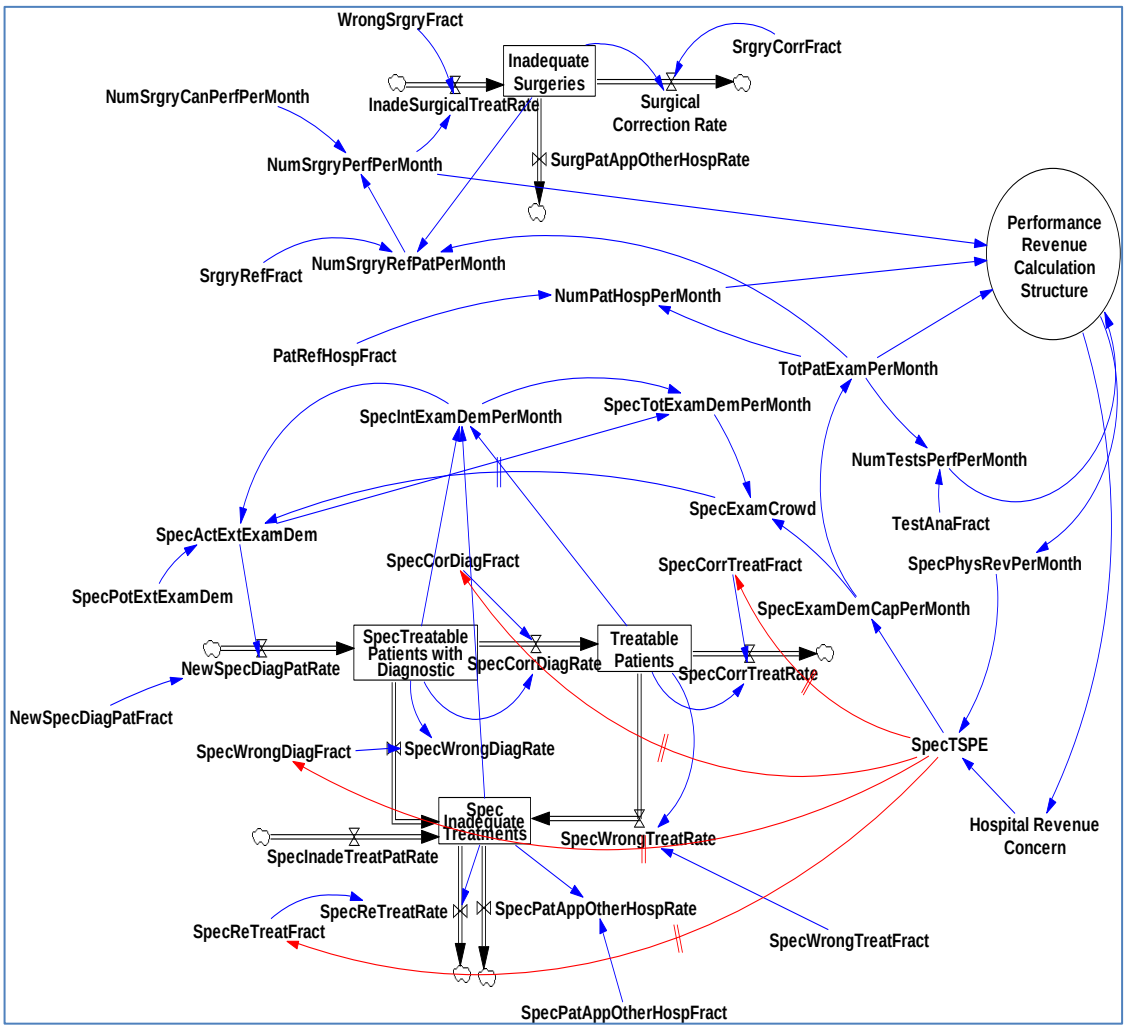

Figure 5: Simplified Version of the Stock-Flow Diagram

Surgical treatment structure includes inadequate surgeries stock variable and its flows. Surgical correction rate and surgery patients applying to other hospital rates are outflow of this structure below. Inflow of Inadequate Surgeries is inadequate surgically treated patients. This flow is multiplication wrong surgery fraction and number of surgery performed per month. Wrong surgery fraction is affected by time spent per surgery.

Two different demand sources are included in model. One is external demand and the other one is internal demand. The internal demand is generated by visits of patients who are still in treatment structure. Internal demand structure is affected by external demand. If internal demand increases due to decreases in health quality or health employee resources, crowding increases as a result. Since hospital has limited capacity for medical activities, external demand can decrease owing to increases in internal demand.

The Demand Formulation Structure is expressed in Figure 6 below:

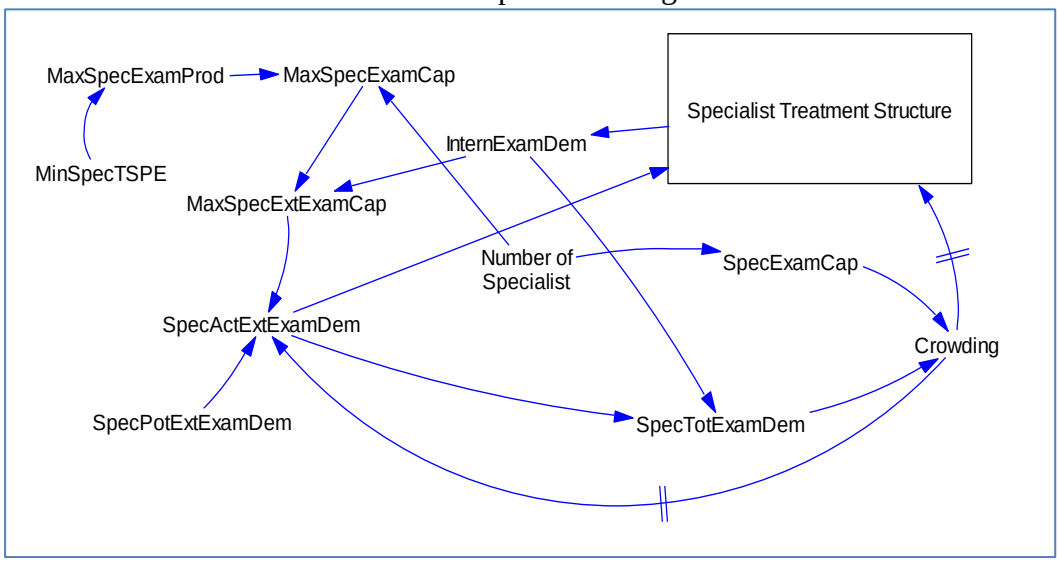

Figure 6: Internal-External Demand Structure

Internal examination demand is generated by specialist treatment structure and affects external demand by effect of crowding in time. Moreover, 15% of external demand increases internal demand each month.

Crowding has negative effects on treatment structure. If crowding increases, ın order to meet the demand, physicians may reduce time spent per examination (TSPE). They may spend less time per patient and focus on increasing examination productivity to close the gap. However, decreases in TSPE have negative effects on diagnose and treatment flows. If a physician spend less time on TSPE, wrongly diagnosed patients and inadequately treated patients increases meanwhile reverse effects on correct treatment and diagnose flows. Thus negative effects of crowding result as increase in internal demand. Due to increase in crowding, external demand may decrease.

PBPS has complex revenue formulations. Physicians perform medical activities and in return, they obtain performance points. Each medical activity has unique performance points. Physicians may prefer high incentivized points in order to increase their individual performance. Current performance point formulation is composed of individual and group based performance point calculation. In order to gain model simplicity and not to lose important effects and interactions, the following formulation in Figure 7 is used.

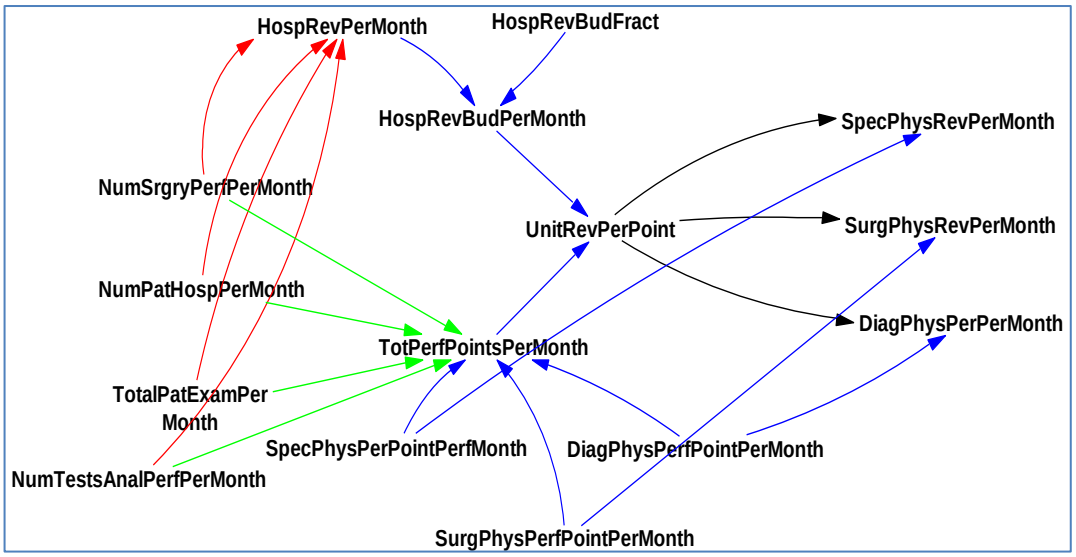

Figure 7: Performance Revenue Calculation Structure

4. MODEL FORMULATIONS

4.1. Treatment and Diagnose Rates

One of the main structures in the model is specialist treatment structure. This structure represents diagnose and treatment process (Figure 8, below). External demand is the input of this structure. SpecActExtExamDem represents actual external examination demand to specialists per month. 15% of external demand is input of this structure.

Possible diagnose and treatments are included in model. This treatment structure is for special patients. These patient's needs, diagnoses and treatments are different from the average patients. They visit hospital more than normal patients. Treatment of these special patients requires more effort and time. What is meant by possible treatment or diagnose is that physicians can only treat or diagnose as much as a percentage of their examination capacity.

$$PosCorrDiagRate = NumTestsPerfPerMonth * PosCorrDiagFract$$

$$SpecCorrDiagRate = MIN(PosCorrDiagRate\ Treatable\ patients\ with\ diagnostic * SpecCorrDiagFract)$$

$$PosWrongDiagRate = NumTestsPerfPerMonth * PosWrongDiagFract$$

$$SpecWrongDiagRate = MIN(PosWrongDiagRate\ Treatable\ patients\ with\ diagnostic * SpecWrongDiagFract)$$

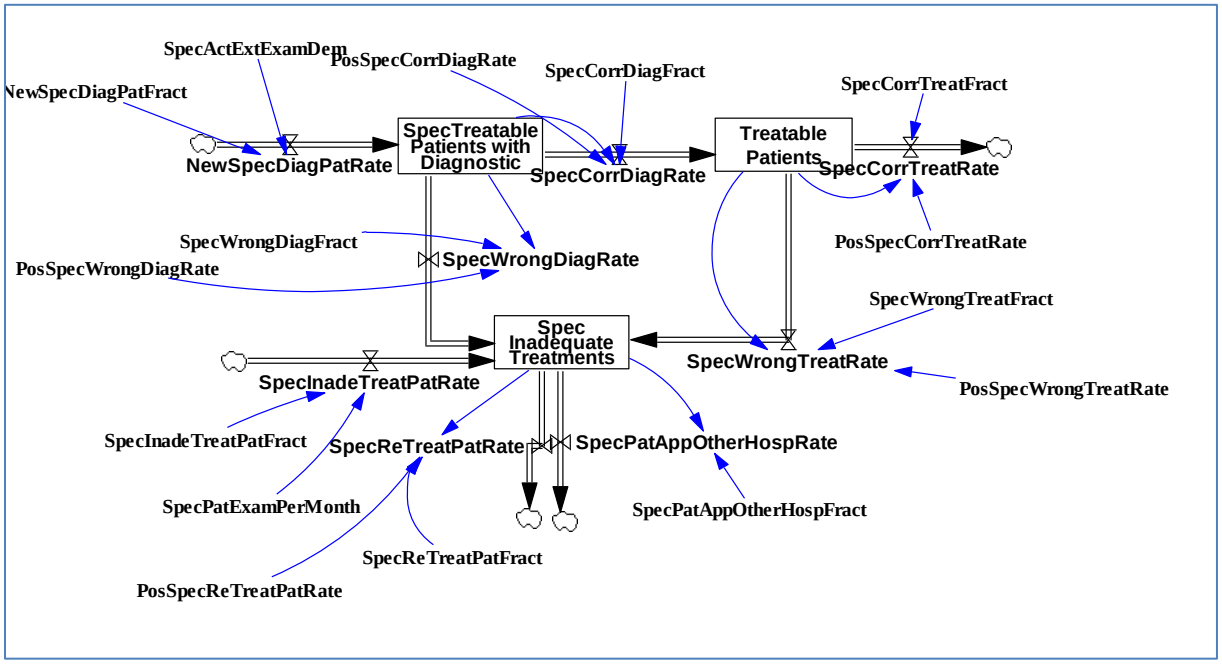

Figure 8: Treatment Structure

4.2. External-Internal Demand Formulations

External demand in the model is a function of potential external demand and examination capacity of hospital. Potential external demand is constant whereas actual external demand is function of potential external demand, examination capacity and crowding effects. The simplified version of this formulation is expressed in Figure 9.

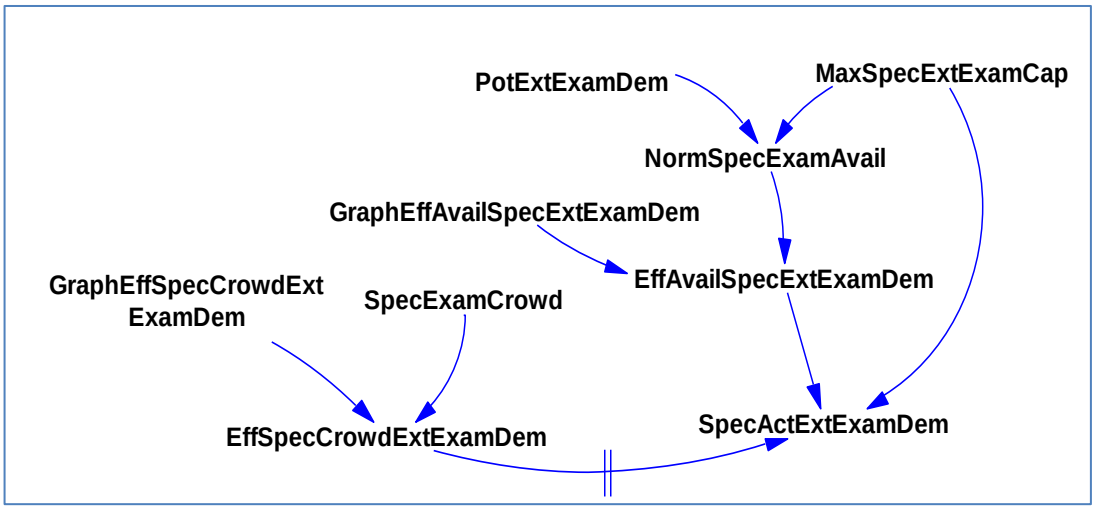

Figure 9: External-internal Demand Structure

One of the main effects in this formulation is effect of availability on actual external examination demand. Patients can generate examination visits to hospital with respect to its examination capacity. In order to include this assumption into the model, the following equations are used.

$$NormSpecExamAvail = PotExtExamDemSpec/MaxSpecExtExamCap$$

$$EffAvailSpecExtExamDem = F(NormSpecExamAvail)$$

It is assumed that specialist examination crowding has a negative effect on external demand. If the crowding is far higher than average, than the patients whom apply for medical service cannot get any treatment or examination. Lack of health service induces patients to seek other hospitals to fulfill medical needs.

$$SpecExamCrowd = TotSpecExamDemPerMonth/SpecExamCapPerMonth$$

$$EffSpecCrowdExtDem = F(SpecExamCrowd)$$

$$SpecActExtExamDem = EffAvailSpecExtExamDem * MaxSpecExtExamCap * DelEffSpecCrowdExtDem$$

The following graph displays the relationship between examination crowding and external demand. As it can be seen from the graph above, there is a negative relationship between crowding and external examination demand. If examination capacity is higher than demand then low crowding stimulate more potential patients to apply to hospital for medical services.

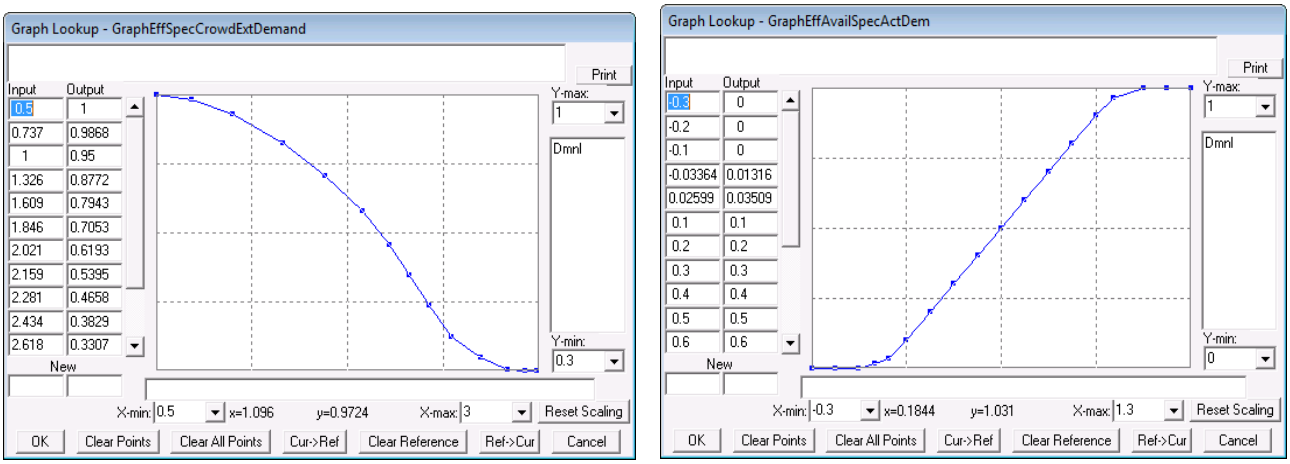

Figure 10: Effect of Crowding on External Demand

4.3. Time Spent Per Examination

Time spent per examination is one of the most important variables in the model. In order to provide adequate and quality diagnose/ treatment, time is vital. If physicians spend more time on examinations, they can spend more time for taking information about patient's complaints. With the aid of better knowledge and understanding of patient's complaint, physicians may make more accurate diagnoses and adequate treatments.

It is assumed in the model that time spent per examination is affected by physicians' and hospitals' revenue concerns and medical activities' crowding. The formulation of this variable in model is combination of additive-multiplicative effect formulation. If physician's revenue is lower than the reference, than the physician may feel a pressure and obligation to produce more examinations to get more performance points. If physician's revenue is higher than the reference, than the physicians may focus on making more accurate diagnoses and

correct treatments. The effect of physician revenue has greater effect on TSPE than hospital revenue concern.

Hospital revenue is important to describe the effects on TSPE. Hospital revenue is strictly related to medical operations that perform in hospital. Thus, hospitals which have lower revenue than average, feel bankrupt pressure on themselves. Their managers seek ways to increase hospital revenue. Thus, they induce physicians to spend less time on examinations to increase productivity and examinations.

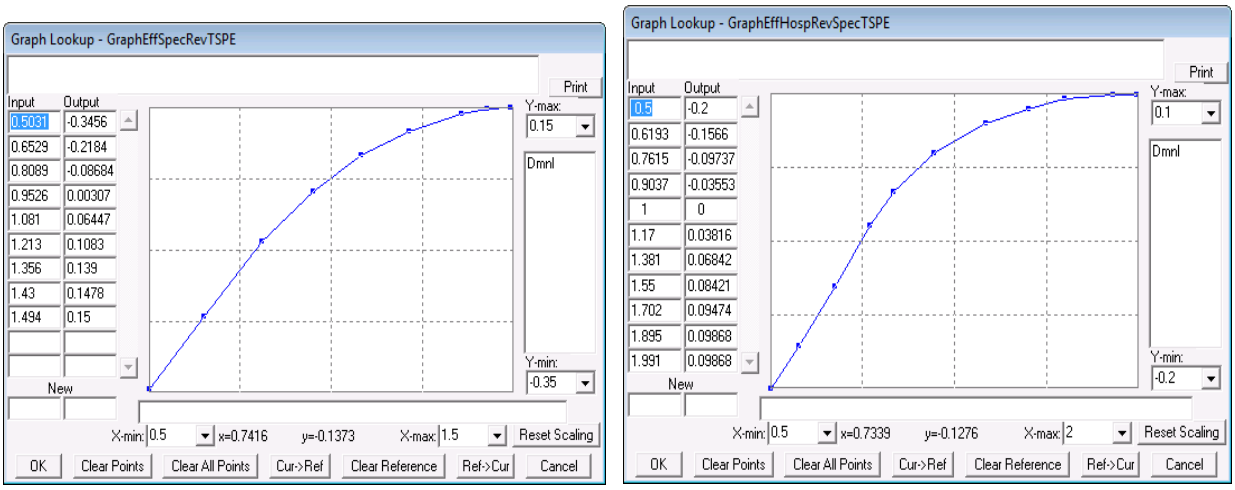

Figure 11: Effect of Specialist and Hospital Revenue on TSPE

Time spent per examination is also affected by crowding. Crowding is a function of examination demand and examination capacity. There is a negative relationship between crowding and TSPE. If crowding is higher than reference, physicians feel pressure of meeting the examination demand. Thus, they spend less time on examination; give second priority to adequate treatments. By decreasing TSPE, physicians can examine more patients and gain better performance revenue.

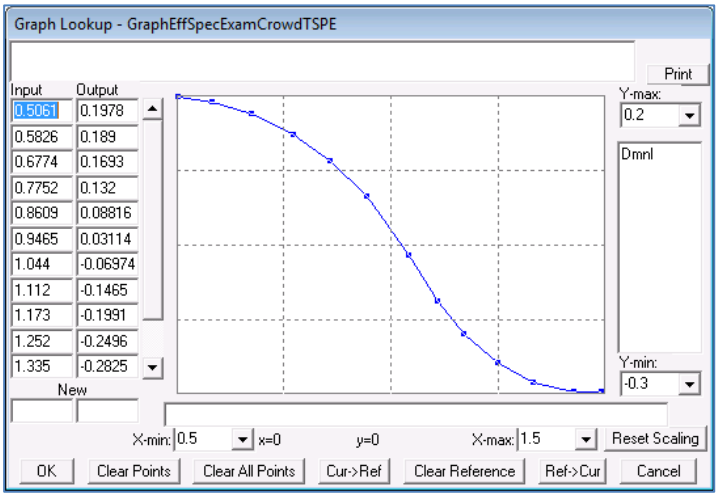

Figure 12: Effect of Specialist Examination Crowding on TSP

The resulting equation is:

$$SpecTSPE = NormalSpecTSPE * (1 + DelEffHosRevSpecTSPE + DelEffSpecExamCrowdTSPE + DelEffSpecRevTSPE)$$

4.3.1. Effects of TSPE on Correct and Wrong Diagnose Rates

TSPE has important effect on correct and wrong diagnose rate. If physicians spend more time per examination, they may diagnose patients more accurately and treat patients more correctly. There is a positive relationship between TSPE and correct diagnose rate and negative relationship between TSPE and wrong diagnose rate. The following graphs show the relationship between TSPE and these variables.

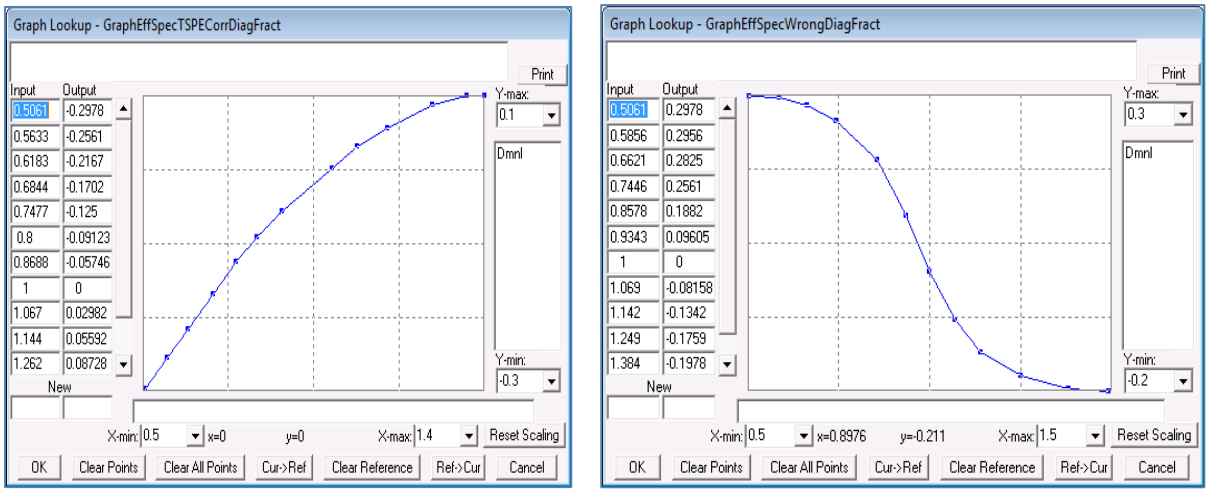

Figure 13: Effect of TSPE on Correct and Wrong Diagnose Rate

4.4. Hospital Revenue Formulation

In current performance revenue formulation in Turkey, hospital revolving budget has a complex calculation method. Hospitals can distribute only 40% of their income to physicians when they achieve the best performance points according to PBPS. In order to model only related aspect of real system, the revolving budget formulation is simplified. Reference revenue is added into model. And this variable is calculated by hospital resources, private sector second step public hospital base revenue and public second step hospital base revenue. The following diagram demonstrates the relationship between these variables.

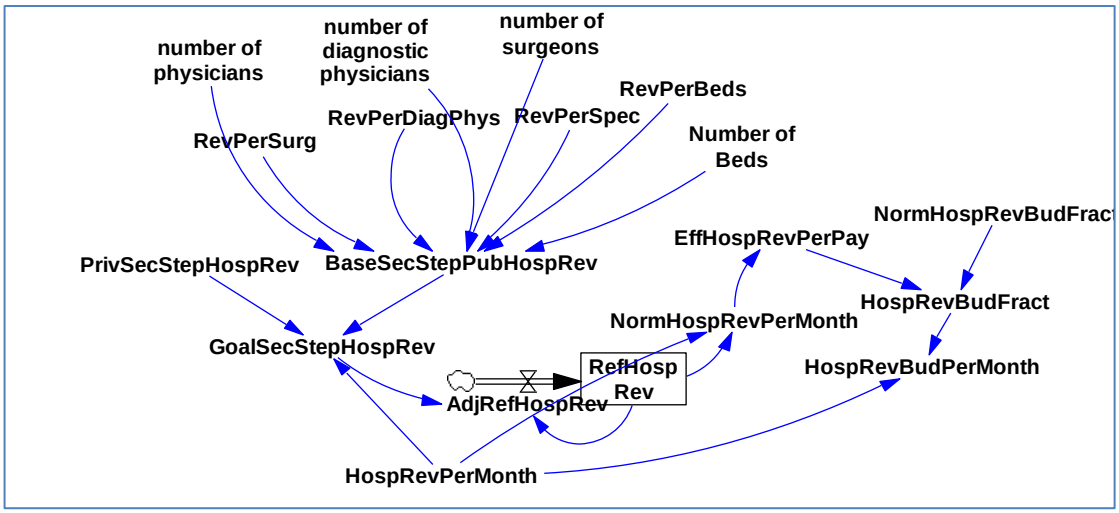

Figure 14: Hospital Revenue Formulation

$$BaseSecStepPubHospRev = Number\ of\ physicians * RevPhysSpec + Number\ of\ surgeons * RevPerSurg + Number\ of\ diagnostic\ physcians * RevPerDiagPhys + Number\ of\ Beds * RevPerBeds$$

$$GoalSecStepHospRev = BaseSecStepPubHospRev * 0.2 + PrivSecStepHospRev * 0.2 + HospRevPerMonth * 0.6$$

$$PrivSecStepHospRev = BaseSecStepPubHospRev * 1.5$$

$$NormHospRevPerMonth = HospRevPerMonth/RefHospRev$$

$$HospRevBudPerMonth = HospRevBudFract * HospRevPerMonth$$

Goal reference formulation for hospital revenue is the weighted average of hospital current revenue, base public hospital revenue and private hospital revenue. Weight of hospital revenue is higher than other revenue variables, because it represents average of all second step public hospitals and it has greater effect of calculation of goal hospital revenue.

5. MODEL VALIDATION

The aim of model validation is to assure that the model is an acceptable description of the real system behavior with respect to the dynamic problem [16]. Model validation is executed in two steps: structure and output behavior testing.

5.1. Structure Validity

Structure test is to check whether the structure of a model is a meaningful description of the real relations that exists in the problem [16]. There are two types of structure tests: direct structure tests and indirect structure tests. In the model all parameters and variables have real-life counterparts. The model is dimensionally consistent in all equations.

One typical indirect structure testing is extreme condition testing. In order to check whether the model is valid or not, some extreme conditions are simulated. One of model

inputs is external demand, and external demand is affected by potential demand. If potential external demand is zero, then there is no input to the treatment structure. Thus, total demand (including internal one) decreases due to the lack of external demand as expected.

Another extreme-condition test is applied on the effect of physician revenue on TSPE. When examination capacity is higher than demand, there is no decrease in TSPE due to revenue concern, as expected. In addition to this, an extreme condition test is applied to health resources. When there is only one physician, all treatment stock levels decrease drastically as expected. These and other extreme condition tests are consistent with real life information.

5.2. Base Run

As seen in Figure 15, inadequate treatment stock reaches its new high equilibrium level in 30 months. Inadequate treatments increase due to decreasing health quality indicators like TSPE. Treatable patients and treatable patients are stable due to slow changes in flow variables of Figure 16.

As it can be seen in Figure 17, time spent per examination and surgery decreases within 30 months. This is a result of revenue concerns. Physicians tend to spend less time on medical activities to increase their revenue.

In Figure 18, it can be seen that PBPS has negative impact on quality indicators. Due to spending less time on medical activities, correct treatment and diagnose ratios decrease as expected.

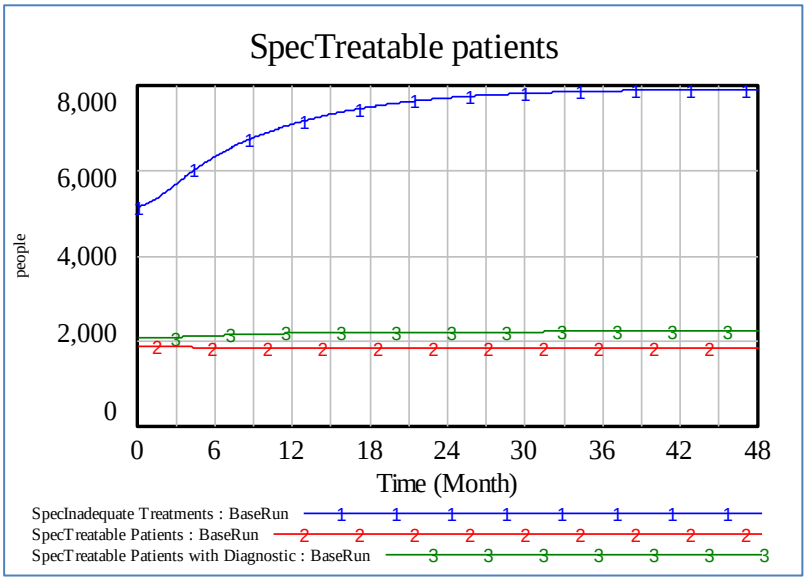

Figure 15: Treatment Structure-Specialist Physician Main Stocks

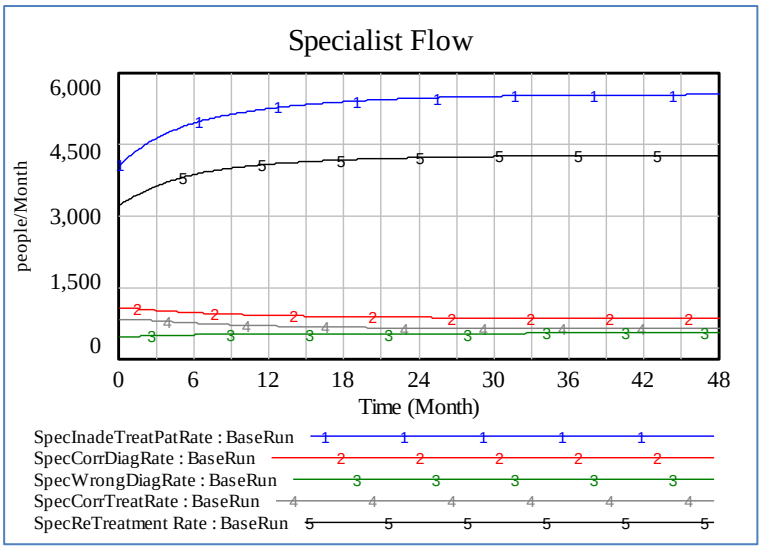

Figure 16: Treatment Structure 2-Specialist Physician Main Flows

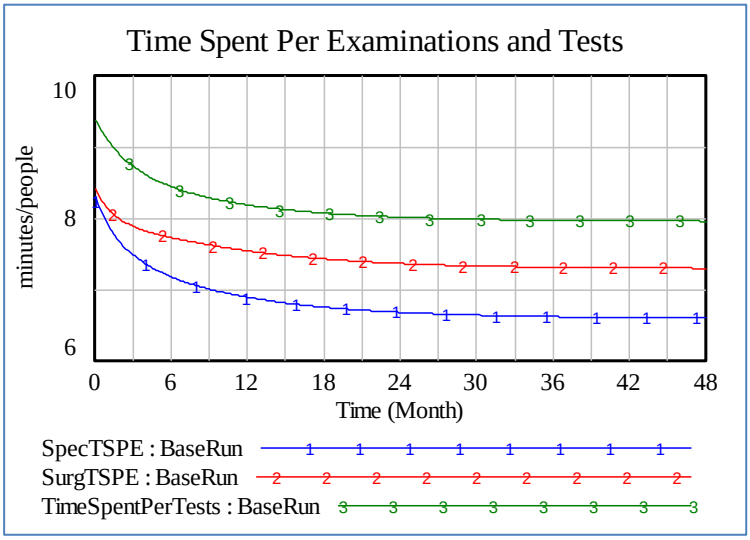

Figure 17: Time Spent Per Examination and Tests

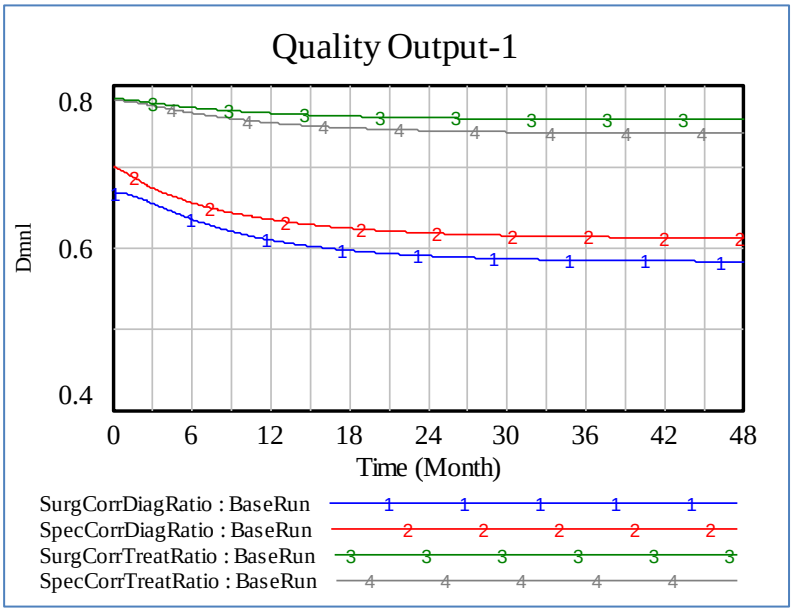

Figure 18: Correct-Wrong Diagnose and Treatment Ratios

5.3. Behavior Validity

Behavior pattern tests are designed to measure how accurately the model can reproduce the major behavior patterns of the real system [16]. Real data is limited for our study. There is no available data for TSPE or other quality indicators. But we can guess the real system behavior by looking into the patterns in other health over the years since PBPS implementation.

According to the model assumptions, there is a negative relationship between physician's revenue concerns and health quality. Since the physician's revenue is lower than the reference revenue, physicians spend less time per examination and perform more examinations and medical operations to improve their revenue. As a result, physicians' revenue is expected to increase after P4P. In Figure 19, it can be seen that, the model and the real data is well-matched in first year. However; owing to the continuous changes in government policies and operations' pricing, physicians' revenue decreases in second year. Between 2007 and 2009, the real-life behavior is stable just like model's behavior.

With increases in health resources' capacity, medical operations performed per year increase after P4P. In Figure 20, Figure 21 and Figure 22, the model's behavior and the real data are well-matched. The real data for medical operations are taken from a second-step public hospital in Istanbul.

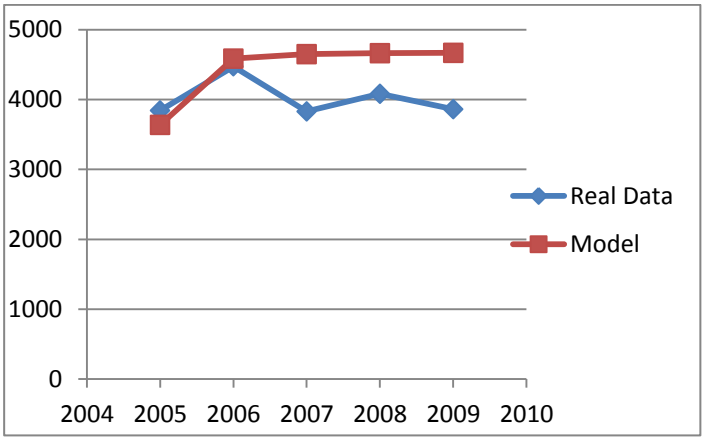

Figure 19: Physicians' Revenue per month (MOH, Statistical Yearbook 2011)

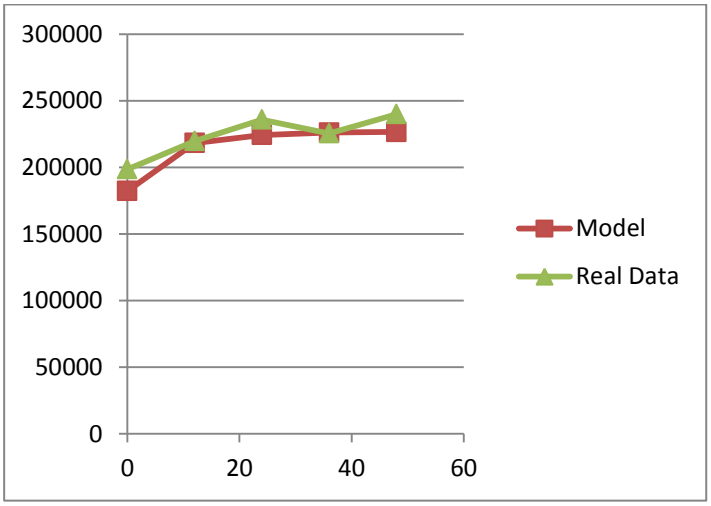

Figure 20: Number of patients examined per month

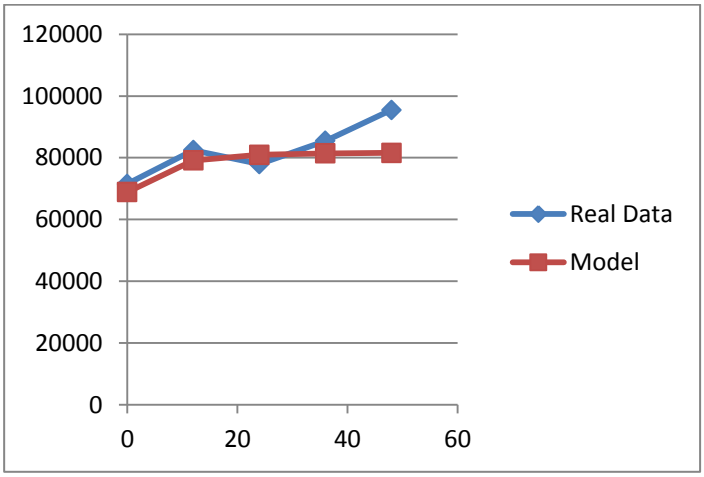

Figure 21: Number of tests performed per month

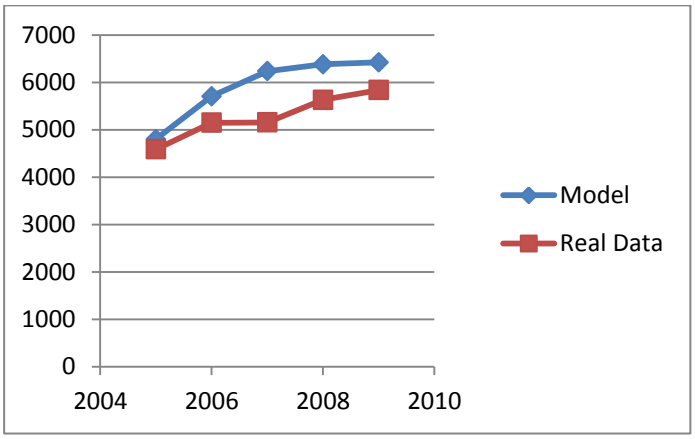

Figure 22: Number of surgeries performed per month

6. SCENARIO ANALYSIS

6.1. High Incentive for Performance, Adequate Demand, Adequate Physicians

In this scenario, government's primary goal is to improve health service quality. Adequate health budget gives MOH flexibility to carry out their performance program.

In order to reach this goal, government first increases health employee resources. Main expectation is to meet the health demand and increase health productivity. But since there is abundant demand, increases in health employee's numbers would not close the gap between health demand and capacity. Moreover, increases in physicians' revenue also increase their goal revenue in time. Thus, crowding and revenue concerns push physicians to decrease TSPE and to give second priority on healthcare quality. The policy does not yield the desired outcomes, due to compensating feedback loops in the system.

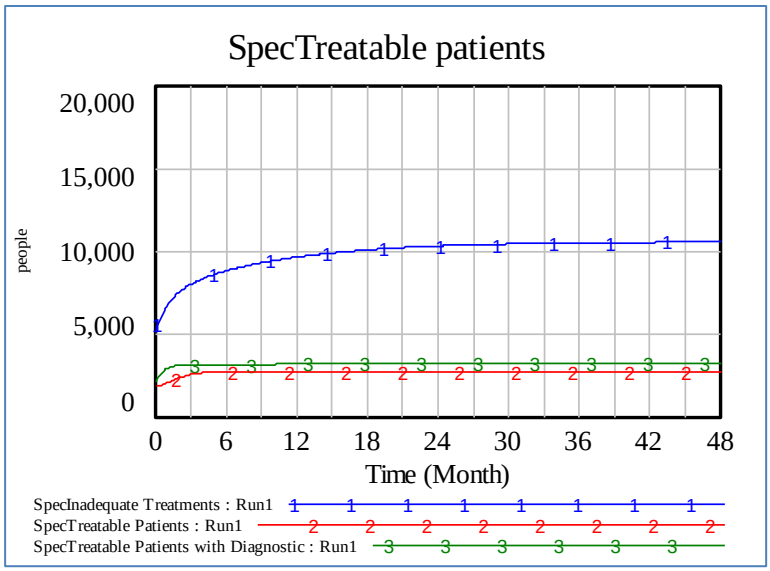

Figure 23: Specialist Physician Patient Stocks

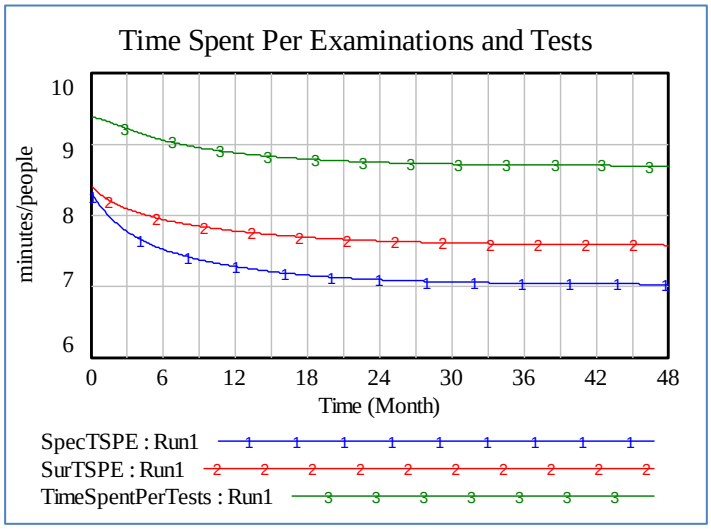

Figure 24: Time Spent Per Examination and Tests

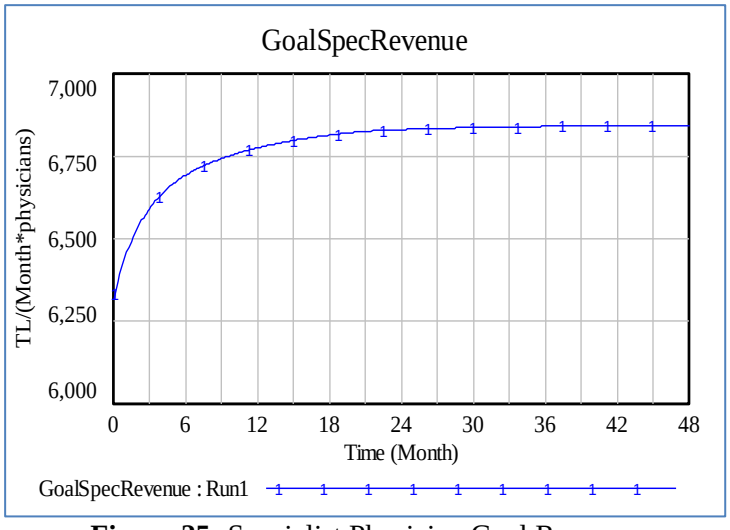

Figure 25: Specialist Physician Goal Revenue

6.2. Economic Crisis-Budget Cuts

In this scenario, government faces a big economic crisis. MOH cannot provide high incentives for medical activities anymore. Due to decreases in performance payment system, physicians prefer working in private sector. As a result, public health employees are lower than that in base model. Moreover, private hospitals increase the physicians' base revenue to increase their productivity and market share.

Since the performance revenue of physicians is far lower than that in the base run, physician's revenue pressure is expected to be high. Moreover, decreases in health resources do not solve the unmet health demand problem. As a result, examination and surgery crowding increases due to inadequate number of health employees.

In Figure 26, it can be seen that times spent per examination and test decrease due to increases in crowding and revenue concern of hospital and physician. Physicians can increase their revenue by improving their productivity.

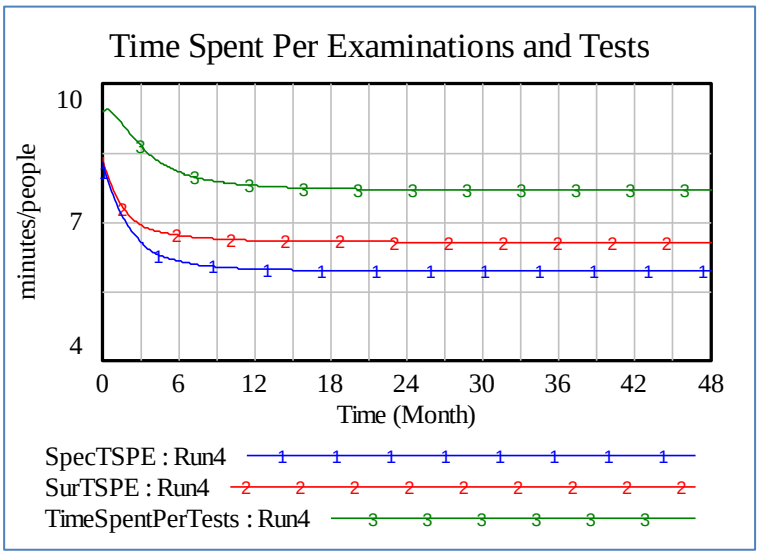

Figure 26: Time Spent Per examinations and tests

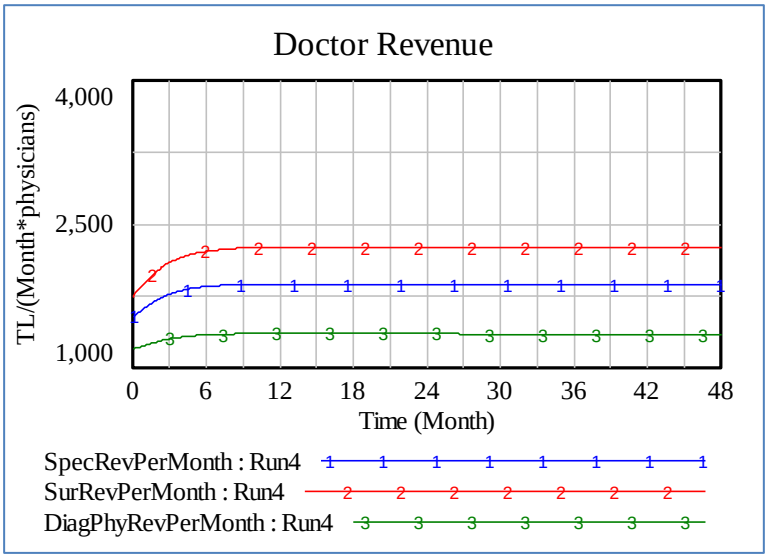

Figure 27: Physician Revenues

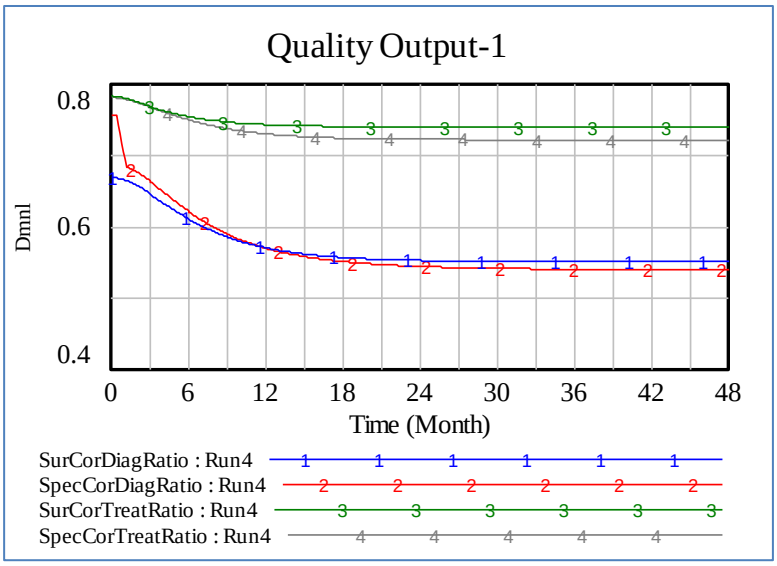

Figure 28: Correct Treatment and Diagnose Ratios

6.3. No PBPS at all

If payment system is not based on medical performance of physicians, they still have revenue pressure but they don't have opportunity to improve their performance for increasing their revenue.

In this scenario, the effects of PBPS are excluded from model. Physicians' productivity is only affected by the hospital crowding. Due to the hospital crowding, physicians may spend less time per examinations and medical activities.

Although physicians' revenue is lower than their goal revenue, they can't increase their revenue by performing more medical activities. These behaviors can be seen in Figure 29 and Figure 30.

No significant dynamics are observed in this scenario. Absence of revenue-related effects eliminates the adverse effects of PBPS on quality indicators. This can be seen in Figure 31.

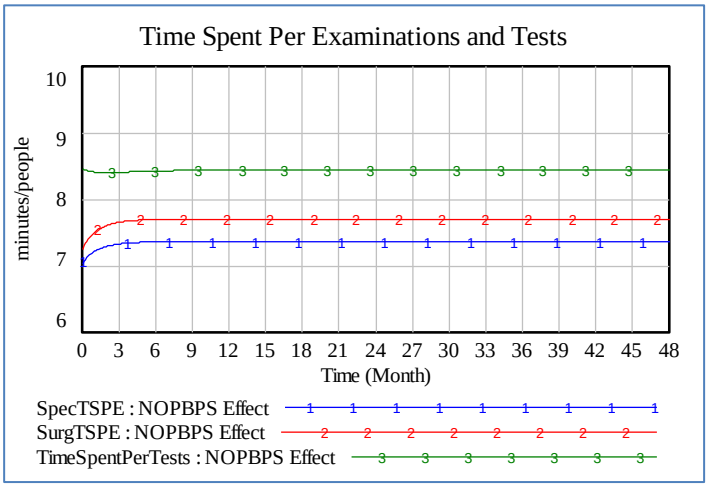

Figure 29: Time Spent Per Examination and Test

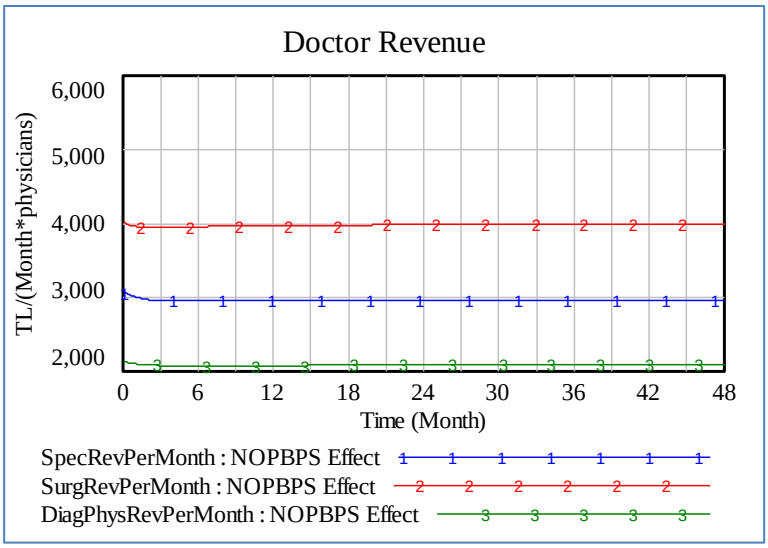

Figure 30: Physicians' Revenues

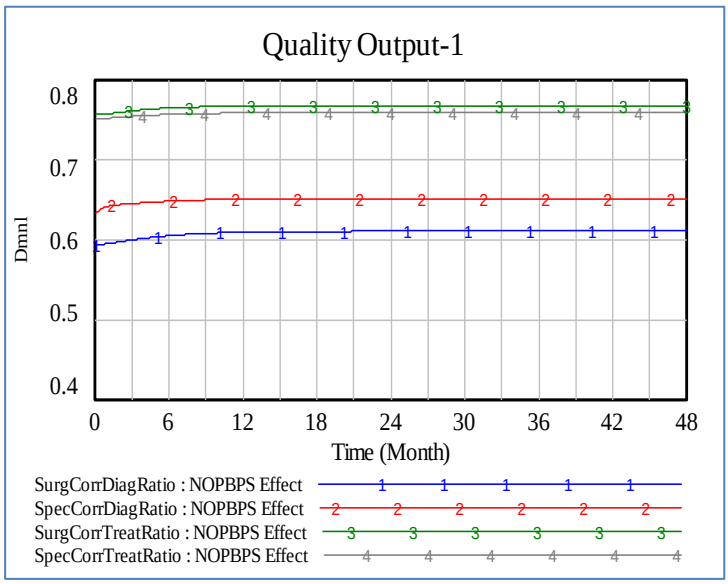

Figure 31: Correct diagnostic and treatment ratios

6.4. Abundant Demand-Inadequate Specialist Physicians

In this scenario, number of physicians is decreased from 20 to 10. Hospital examination crowding increases as expected. Physicians experience the pressures of revenue and crowding. As a result, they try to increase their productivity by decreasing TSPE. This behavior can be seen in Figure 32.

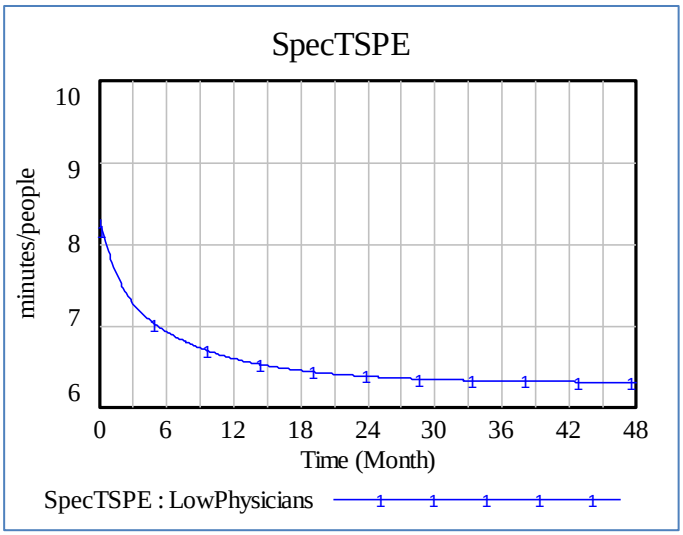

Figure 32: Time Spent Per Examination

By performing more medical activities, physicians increase their revenue, which can be seen in Figure 33.

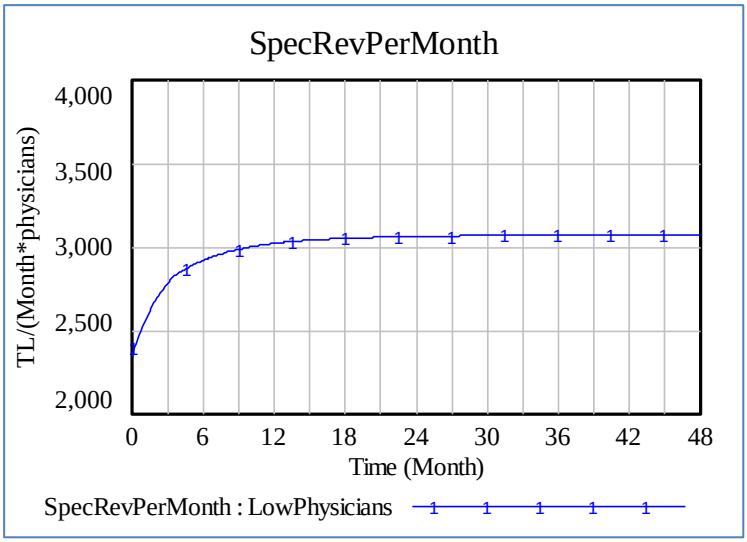

Figure 33: Specialist Physicians Revenue per Month

6.5. Inadequate Demand-Low Performance Payments

In this scenario, there is inadequate demand for examination. Potential external examination demand to physicians is decreased to 3000 people/month. In addition to this, performance point per examination is decreased to 10 points/examination.

Although, specialist physicians' revenue is far lower than their goal revenue, they do not have opportunity to increase their income by examining more patients. The reason behind this situation is inadequate examination demand. Thus, time spent per examination doesn't decrease as a result of specialist's revenue concern, as expected. This behavior can be seen in Figure 34.

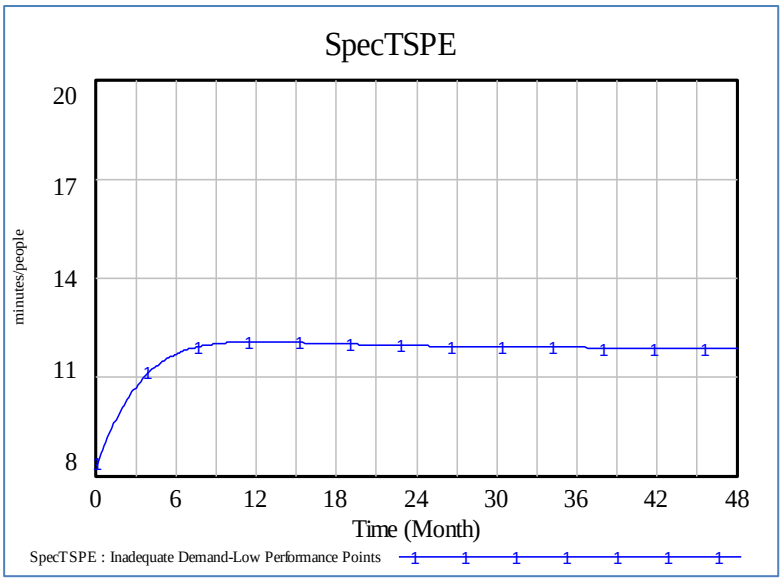

Figure 34: Time Spent Per Examination

DISCUSSION AND CONCLUSION

The aim of this study is to investigate dynamic impacts of *performance based payment system* (PBPS) on health service outputs. PBPS implementation in Turkey considers public health centers as revenue generating places. In order to meet health demand and increase medical productivity, PBPS has been active in *second step* public hospitals since 2004. Considering the long implementation history and share in medical operations, second step public hospital is selected and a model that represents the dynamic effects of PBPS on these hospitals and physicians is built.

Physicians' revenue and their response to government policies are related. With PBPS, physicians have a chance to improve their living standards by obtaining more performance revenue. If physicians already earn satisfactory salaries, then quality variables are expected to be positive with PBPS. In the base run, time spent per examination, performance points for medical activities, health resources and external demand are seen as main factors affecting the system behavior. According to simulation runs, there is a negative relationship with physician's revenue concern and health service quality, because of the fact that physician's revenue is strongly based on his/her productivity.

In scenario analysis, when physicians' revenue concern is high, physicians tend to spend less time per medical activity (examination, diagnostic and treatment) in order to increase their revenue. Quality indicators decrease as can be predicted. Inadequate treatment stocks increase and reach relatively high equilibrium values in 30 months. In another scenario, government decides to decrease the health expenditures and cut down performance points per medical activities. However, there is abundant demand for medical service and physicians can increase their productivity to increase their revenues. Therefore, inadequate and low quality treatments result, as well as crowding in hospitals. Efforts to decrease health expenditures end in failure because of the very structure of payment system.

To sum, this study is an initial effort for understanding dynamic effects of PBPS and presents base model for further studies. As further research, the relationships and competition between public and private health sectors can be explicitly modeled investigated. Moreover, a

university hospital model may be built for investigating different impacts of PBPS. Thus, the effects of hospital revenue on educational and research activities may also be investigated.

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