# Resource allocation and quality of care : a logistic approach

# Resource Utilisation And Quality Of Care; A Logistic Approach

G. de Vries, Eindhoven University of Technology, Netherlands

## 1. Introduction

In manufacturing industry last decade much attention has been paid to develop logistic planning and control systems and to the introduction of quality systems, to improve performance. Important goals are realising client's orders on time, according to the agreed quality, quantity and costs. In health care we have to meet the challenge of scarce resources; national expenditures are limited while demand is still growing. One of the goals is to balance efficiency in the use of resources with good quality of care. A logistic approach which has proved its worth in manufacturing industry might be helpful in health care, but there are essential differences. One of them is that in health care, not good flows but patient flows are primary processes.

As characteristics of a hospital can be mentioned:
- they have to serve ten thousands of patients in a year;
- every patient has his own route;
- there are many independent professional care suppliers;
- output specifications are not known;
- capacities are scarce;
- high utilisation rate is required;
- demand is partly urgent;
- stocks of care cannot be build up.

What makes it complicated to handle this:
- there are many co-ordination problems;
- there are partly conflicting targets:
    - high quality;
    - high throughput;
    - high output;
    - high capacity utilisation.

This article points out that an integral (logistic) approach to control processes, focused on care processes, can be helpful in this complex situation.

## 2. Logistic planning and control

The individual patient has a perspective look from outside to inside. He is subject of a sequence of activities such as doctor's consultation, diagnosis, treatment, surgical

operation. The patient meets several stations on his way through the hospital and expects low waiting times. A system for flow planning and control is required.

The perspective look from a hospital's unit is from inside to outside. A unit has to deal with a sequence of patients with individual work orders. Often demand can only partly be influenced; idle time should be avoided. A system for unit planning and control is required.

There are two main rules for planning and control:
- balance between supply and demand;
- balance between uncertainty and flexibility.

Flexibility is not a goal in itself, but is needed because the demand of care is not deterministic nor static. Like in production processes, buffers are important in logistic control. In care processes buffers do not appear as stock of raw materials, spare parts, finished products et cetera. Buffers appear as waiting times, delivery dates, appointments, waiting lists and waiting rooms. Actually, patients are parked in buffers; this may appear as a stock of patients, but in logistic terms it is a queue. Conflicting targets appear here as a conflict between waiting time for patients and idle time for capacities (including staff): who is waiting for who?

For several reasons it is getting more and more important to control processes and flows:
- reduction of length of stay;
- more short-stay and day-care treatments;
- shift from inpatient to outpatient care;
- growing co-ordination and communication with family, doctor/GP and home care institutions;
- quality requirements from clients.

As said before, a difference can be made in patient flow planning and control and unit planning and control. Both will be elaborated.

**Patient flow planning and control**

Patients run through a chain of activities with different stations. At each station the patient makes an appointment (agreement on delivery time) or he takes place in a buffer (joining other patients in the queue). There are two options for flow planning and control, dependent on predictability of patient-related individual work orders. If individual work orders for the same patient for several units are known in advance, a coherent planning for the individual patient can be made. This approach can be used for operational planning on the short term: a program is set up for each patient, such as:
- a coherent planning for x-ray, ECG, lab test;
- a coherent planning for pre-operative screening, admission and surgical operation.

If individual work orders are not known in advance or for some units or activities appointments are not made (joining the queue), a logistic analysis can be made to get

insight in the logistic relationships of patient flows between units. The co-ordination between units is based upon expected flows with average patterns, and not upon known orders. To get this insight sample patients registration or statistical analysis (diagnosis groups, patterns of order demands) is required. This approach is useful for tactical planning (resource allocation upon a year's base) and operational planning (week schedules). As an example: a logistic analysis indicates that A% of patients visiting the medical outpatient clinic on Thursday morning is sent to the x-ray department; B% of them for an instant x-ray photo which takes less than five minutes production time. It is important to recognise that what cannot be planned is not by definition unpredictable.

**Unit planning and control**

What we see as a unit here is a nursing unit, an operating theatre, x-ray department, laboratory, outpatient department, an individual doctor et cetera. Sometimes a unit is a single resource capacity (a doctor), sometimes a multiple resource capacity: a nursing unit consist of beds, nursing staff and medical staff. Buffers are appearing here as queues (waiting lists, waiting lines, waiting rooms) and as agreed delivery dates for the services to be rendered. Urgency and postpone-ability are important factors here: emergencies cannot be parked in a buffer, so resources should be 'in stock'. For these reasons we have our second main rule: balance between uncertainty and flexibility. We have two types of flexibility, internal and external flexibility.

Internal flexibility means the need of a slack of resources according to the expected demand. We need more resources 'in stock' if predictability is lower. External flexibility has to do with coping uncertainties coming from outside. Ways to create external flexibility and to reduce external uncertainties are:

- predicting the demand;
- making deals about orders and patient flows;
- electing patients, in order to balance supply and demand (the first main rule);
- creating buffers between units, such as an emergency unit to concentrate all the emergent admissions.

**Levels of planning and control**

The systems for planning and control have to be designed for several levels, such as strategic, tactical, operational level and the actual situation (see also the production control framework in the article from Jan Vissers). The characteristics for these levels will be briefly mentioned.

Strategic level:

- determination of functions (quality and quantity) based upon patient's demands (trend analysis);
- development of new activities and/or reinforce activities to influence patient's demand;
- determination of yearly budget and total amount of resources.

Tactical level:

- allocation of budgets and resources to units, based upon an expected volume of production;
- determination of coherent schedules for all units, based upon expected flows (week patterns) and upon logistic interrelationships between units.

Operational level:

- scheduling of patients and scheduling of activities;
- allocating the resources to patients;
- reserving a part of the resources (slack), dependent on the unpredictability.

Actual situation:

- adjusting the operational planning, if necessary;
- using measures for flexibility, to meet unpredicted urgencies and to keep actual workload in balance.

## 3. Logistic information

It will be quite clear that we need logistic information to support our logistic planning and control systems. Logistic information should be directed upon patient flows and product lines. Timeliness is an explicit factor in logistic systems and also in hospital's performance. Parameters referring to timeliness are delivery time, reliability of delivery time, access time and waiting time. We can also say that these current parameters define our logistic quality rendered to the clients. Unfortunately present hospital information systems in general do not give information on timeliness and logistic quality.

Related to logistic planning and control, there are two types of logistic information: logistic process information and logistic management information.

### Logistic process information

Logistic process information is related to operations and to the process of the individual patient. In practice we use a small set of indicators for urgency: it is urgent or not. The label 'urgency' guarantees immediate action; this can be an invitation to manipulate with that label. If the label is used, it is not known if any delay is allowed. Another problem is the overview of patient-related activities. Generally a unit only knows its own order (such as a request for a lab test, or an x-ray), and not if there are any more orders for the same patient for other units.

Better co-ordination, coherent information and more detailed urgency indicators are required. From a quality point of view, more knowledge about client needs and expectations and about logistic performance is required.

As an illustration the required logistic process information for the operational admission planning and control is listed:

- patients' load on beds (included length of stay), nursing manpower and operating time; these loads can be derived from patient's data on admission diagnosis, surgical operation code, age and sex;
- indication of urgency for each patient on the waiting list;
- percentage of urgent (non-elective) admissions for different specialists (surgical and medical), in order to make bed reservations;
- prediction of date of dismissal and resulting nursing workload; predictions can be made explicitly (derived from patient's data, based upon statistical research) or implicitly (using the expert knowledge of doctors and nurses).

**Logistic management information**

For several reasons there is a need for logistic management information, to support the management in its responsibilities and managerial decisions:

- to get insight in patient flows and resource utilisation, to tune the planning and control systems and to improve logistic quality;
- to assess the hospital's performance to the client on timeliness parameters;
- to get insight in patient flow patterns, logistic relationships between units, bottlenecks in throughput, degree of unpredictability, distribution of urgencies in arrivals et cetera.

Patient level information can be aggregated to higher level information on patient flows and product lines. A problem is that we have not the right 'language' to describe patients and patient groups based upon criteria of classification in such a way that it makes sense for both doctors and managers. Sometimes for a dedicated problem sample registration is more useful and efficient than storing large numbers of data in our information systems ('if we put in all possible data, we can get out whatever we want').

## 4. Organisational impact

In general we see a growing attention in health care to the market and a shift:

- from a care supplier orientation to a client orientation;
- from a production/unit orientation to a process/flow orientation.

This development ties logistic and quality approaches together. A feature of a logistic approach is to orientate dominantly upon flows and processes, and not upon unit and production. Many hospitals have a structure based upon production units with highly specialised functions. Over and between these units product-line management is required as a co-operation between the professionals and the managers, with common goals. An information system to support product line management should be developed. A feature of a quality approach is a look from outside to the process performance and output. A patient-centred co-operation between professionals is required, such as case management

and common goals on service and treatment. Information and evaluation systems to monitor quality should be developed.

As a conclusion, both logistic and quality management are based upon:
- orientation on patients and processes;
- process performance control;
- measurement systems, such as performance indicators on resource utilisation and on quality.

Five steps can be mentioned to transform an organisation into a quality organisation.

*1. Best foot forward*
Everyone puts his best foot forward means that quality exists by accident, depending of the ambitions of individuals. This does not mean that quality is by definition bad, but there are no common standards and no systems for quality assurance.

*2. To measure is to know*
Formulating specific goals and measuring the goal performance is essential in basis process control, both from a logistic and a quality point of view.

*3. Our client seems to be our king*
There is a growing consciousness that we are working for our clients and not for ourselves. The orientation on the outside world is starting. As professional experts we know what is good for our clients.

*4. Our client is our king*
In this stage of development we take steps to get insight in our clients' needs and expectations and in their experiences. Instruments such as surveys, panels and evaluation systems are used.

*5. United we stand, divided we fall*
There is a firm belief that the highest quality can only be performed by combining all strengths. That means multi-disciplinary co-operating professionals and client participation. This requires an attitude that we are never too old to learn and that we are always looking for improvements.

## 5. Concluding remarks

Last years a growing number of Dutch hospitals is working with concepts of logistic management and quality management. A recent survey proves that the transformation from policy into specific and measurable goals, and systematic measurement and feed back on aimed performance are still underdeveloped. Yet some proved results can be reported here.

As an example some results will be mentioned on the theme of admission planning, with improvements of both logistic both service quality parameters:

- in stead of one day ahead, a tentative admission and operation planning is made one week ahead;
- patients are called three days before (was one day) and confirmed the day before admission;
- reliable prediction of nursing workload and dismissal date 2-4 days ahead;
- less fluctuations in nursing workload;
- reduction of the number of urgent admissions (the reason was that in a number of cases there was no medical urgency and postponement with a day proved to be possible, if there is a bed for sure tomorrow);
- clear planning and priority rules;
- more time spent to regular planning, less to ad hoc deliberations;
- up-to-date information about the patient-mix and bed occupation;
- more predictability;
- more peace and quiet.

Proved results can also be presented by some facts and figures:

- reduction of emergency admissions: -25%;
- reduction of temporary additional staff: -14%;
- bed occupancy: +4%;
- level of acceptable (objectively measured) nursing workload: +8%;
- implementing a dedicated patient classification and workload control system on a 18-beds Intensive Care Unit:
    - number of admissions per bed per year: +14%;
    - number of admissions per fte nursing staff: +25%.

A conclusion is that improving quality is not by definition expensive. A shift to an orientation on clients and processes, supported by logistic planning and control and by dedicated information systems, can lead to process and performance control with positive effects on both efficiency and quality.