

# Acute pancreatitis: confronting to improve

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## ABSTRACT

Our study is a benchmarking on acute pancreatitis, managed in three different Medical Units. The aim of benchmarking is to optimize time and resources by comparing sufficiently homogeneous reality, to identify areas for improvement and to plan appropriate strategies correction. The observation of heterogeneity in terms of clinical aspects and costs in our hospitals, performed through *benchmarking*, despite our limited case histories, might provide new ideas for future implementation.

## Introduction

Object of our analysis is acute pancreatitis, which presents many gray areas in clinical practice regarding the compliance with the diagnostic criteria, the need and the time of execution of the abdominal computed tomography (CT), the application of a correct prognostic stratification, the inclusion of antibiotics in the therapeutic management, the correct department of destination.<sup>1-4</sup> The observation of heterogeneity in terms of clinical aspects and costs in our hospitals, performed through *benchmarking*, despite our limited case histories, might provide new ideas for future implementation.

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## Materials and Methods

### Benchmarking

In Healthcare, the process of *corporatization* facilitated the introduction of economic and business tools, including benchmarking.<sup>5</sup> In Health Services, the strategic importance of benchmarking depends on three basic points:<sup>6</sup> i) it allows to substitute the absence of a perfect competition market, which can determine a management based on performance and objectives, set internally by the leaders. Benchmarking leads to transcend this limitation; ii) it reduces the self-referentiality of healthcare organizations and stimulates learning from others, with the emulation of best practices; iii) it helps to make the Health Service more efficient and effective.

Benchmarking can be considered a learning process through continuous and systematic approach to identify benchmarks (performance standards), compare them and identify practices that allow to become the new best in class (reference standard). Benchmarking also directs the observation on the manufacturing processes and not just on the output (product).

The main utilities of *benchmarking*<sup>7</sup> are: i) the possible objective assessment of a process by comparison with similar processes of other organizations, so as to identify their strengths and room for improvement and stimulate change; ii) the possibility of using the *know-how* of other organizations as a basis for the formulation of new ideas, with the possibility to identify the practices leading to a superior performance and integrating them in your organization; iii) a support for enlarging the organization experiences, satisfying the logic of *learning organization*. In fact, *benchmarking* techniques, with the introduction of the external perspective, allow the identification of clearer strategic objectives, spurring the entire management system to continuous improvement.

Objects of evaluation and comparison, in the process of *benchmarking*, are business processes. The

term *process* means the structured sequence of activities, to reach an *output* also defined as *product*.

There are different types of *benchmarking* on the basis of comparison mode:<sup>6-10</sup> i) internal *benchmarking*: comparison between units of the same company; ii) external or competitive or strategic *benchmarking*: comparison between companies in competition with each other or between different companies; iii) functional *benchmarking* of process: comparison of similar processes, but in different sectors; iv) generic *benchmarking*: comparison with practices and processes different from those of investigation, in order to draw general procedure indications.

There are also different types of *benchmarking* based on the object of comparison mode:<sup>6-10</sup> i) operating *benchmarking*: comparison limited exclusively to processes, which leads to products delivery and/or provision of services; ii) management *benchmarking*: comparison of procedures used to support the production and delivery line; iii) strategic *benchmarking*: analysis of the determinants of competitive advantage by monitoring the strategic choices of the competitors.

The external or competitive *benchmarking* (that we used) analyzes a process, by starting a comparison between external parties.

The sequence of *benchmarking* phases can be traced back to the methodological cycle of Deming (Deming wheel), known as *Plan, Do, Control, Act*, which identifies four general stages, closely related to each other (Figure 1).

### Identification of targets

In order to use homogeneous data through *benchmarking*, we analyzed the cases of 10 patients with acute pancreatitis (AP) of our three Operative Units (OU) with clinical and economic analysis, simplified compared to the process analysis method. Therefore, we defined specific clinical and economic goals.

To do so, we decomposed the patient's path in the hospital in the individual phases (take-over in First Aid, hospitalization, discharge) and analyzed the elements of the process formation.

So, we defined the following objectives: i) *comparison of clinical and economic impact* (in terms of appropriateness, *inputs, outputs, outcomes*) of diagnostic and therapeutic pathways in the three OUs for patients with AP; ii) *comparison of management route* of patients with AP in the three OUs, with reference to diagnostic tests and specific use of therapy.

## Results

### Identification of cluster of reference

The *competitors of benchmarking*, subject of this thesis, are two Departments of Internal Medicine with

similar characteristics and therefore comparable (Cattolica and Collevero) and an Emergency Medicine (Catanzaro) (Table 1), with different characteristics; however, the diversity is a source of further comparison, since the admission of patients with AP happens in Italian hospitals in different settings. Furthermore, the three wards represent three different geographical areas of Italy (Center/North, Center, South).

Structurally, the OU of Cattolica is part of a small hospital, without Intensive Care and Surgery Unit, which are present, however, in a proximal Hospital; the other two OUs are included in a mean-size and a large-size Hospital, respectively, and they are both equipped with a Surgery and a Resuscitation (Collevero and Catanzaro).

With regard to some of the structure indicators we selected: i) the three wards have a number of annual admissions which in Cattolica is comparable to Collevero, and in Catanzaro it is smaller (lower number of beds) but with a bigger variety of types of admissions; ii) absolutely equal the average weight of the disease-related group; iii) there are some differences about the average length of stay and the employment rate. Particularly, the average hospital stay is shorter in the Emergency Medicine of Catanzaro and equal in the other two Departments (slightly above the national standard of 7 days).

The employment rate is higher in the Emergency Medicine of Catanzaro, but all three OUs have average rates higher than recommended by the National Health Plan, which is 70-75%.

The staffing is different in the three departments. In fact, the number of physicians is greater in Collevero (8 doctors), lower in Catanzaro (4 doctors). In the Department of Cattolica there are more nurses and support workers; in Catanzaro the support staff is absent.

In Table 1 are shown the characteristics of the three wards.

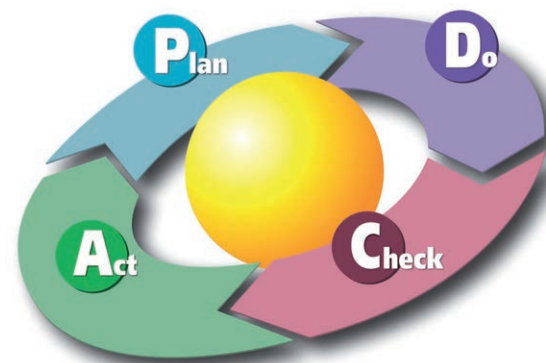


Figure 1. Deming cycle (diagram by Karn G. Bulsuk: <http://www.bulsuk.com>).

In the three wards, medium age is 60/77 years (younger in Catanzaro, older in Colleferro), less than the average of admissions in medicine (78 years).<sup>10</sup> Comorbidity is well represented, in relation to the characteristics of every single ward (gastroenterology in Cattolica, cardiovascular in Colleferro, polyfactorial in Catanzaro) with high prevalence of multiple comorbidity (70% Cattolica, 60% Colleferro, 100% Catanzaro). Pancreatitis etiology is mainly lithiasic in Cattolica, alcoholic in Colleferro and of both types in Catanzaro. Necrotic-hemorrhagic type is 20% in Colleferro and 10% both in Cattolica and Catanzaro. Local complication (pseudocysts, splenic thrombosis, *etc.*) 10% (three cases). Extra-abdominal complications (pulmonary, septic): 20% Cattolica, 30% Colleferro, 10% Catanzaro. No deaths or re-hospitalization (within 60 days) related to AP occurred.

In Table 2 it is shown a comparison of patient's clinical data.

### Comparison of the phases in emergency room

Relating to prognostic, diagnostic and therapeutic characteristics, we summarized (Table 3) first aid (FA) waiting times and acceptance phases.

### Prognostic stratification

Prognostic stratification in AP patients is crucial for the correct clinical pathway: from the choice of the setting of hospitalization to diagnostics, until the therapeutic management. Table 3 resumes any prognostic evaluation tools used, respectively, in the three Departments. Finally, the quantitative value of some of these prognostic scores is compared, in order to further characterize the gravity of pancreatitis in the three Units.

### Comparing the three Medicine Units

In Table 4 we resume diagnostic and therapeutic effort in the three wards; a summary of compared therapeutic approaches is shown.

### Direct costs

In Table 5 we summarize direct costs of diagnosis and treatment in the three structures, with a comparison of hospitalization costs for AP.

## Discussion

### Clinical analysis of variances

Through the analysis of the information collected so far, this macrophase has set as its primary objective the identification and measurement of differences in the clinical management of the diagnostic and therapeutic pathways of AP in the three Units.

The populations examined were substantially enclosed in a range between 60 and 77 years (the youngest in Catanzaro, the oldest in Colleferro). The percentage of males and females is heterogeneous, with prevalence of male in Colleferro and female in Catanzaro.

Among etiological factors, the most represented were lithiasic etiology in Cattolica and alcoholic in Colleferro. In all OUs, patients had at least one comorbidity, often multiple, for expression of the complexity of the internal medicine patient.

Local and systemic complications in 20-40% of cases (more in Colleferro, where the percentage of necrotic-hemorrhagic pancreatitis was also increased

**Table 1. The characteristics of the three wards.**

#### Staff, structural endowment and background

##### Internal Medicine Unit, Cattolica

Cattolica Internal Medicine (Cervesi Hospital, area Riccione-Cattolica, II Internal Department, ASL Romagna) is organized in ordinary hospitalization (33 accredited beds) and ambulatory activity in network with Rimini and Riccione Hospitals. In 2014, this network is extended to Cesena, Ravenna and Forlì.

In ordinary hospitalization, main activities are: gastroenterologic diseases, metabolic-rheumatological diseases, Oncologic care and Rieducational support in collaboration, respectively, with Cattolica Oncology Service and Physiatriac Center. Outpatient activity: Internal Medicine, Hepatology-Gastroenterology ambulatories, Internistic Ultrasound Service and Interventional Ultrasound Service.

##### Internal Medicine Unit, Colleferro

Colleferro Medicine Unit (Parodi-Delfino Hospital), part of ASL RMG Medical Department, is organized in ordinary hospitalization (26 accredited beds), Day Hospital Service (3 accredited beds) and ambulatory care.

In ordinary hospitalization, most common diseases are: heart failure, stroke, diabetes, thromboembolic events, infections, chronic obstructive pulmonary disease and cancer (lung, pancreatic, digestive and non-solid neoplasm correlated with geographic pollution). Outpatient activity is divided between Internal Medicine, Thromboembolic, Respiratory and Pneumology Ambulatories, Diabetic Centre.

##### Emergency Medicine Unit, Catanzaro

Catanzaro's Emergency Medicine Unit, part of Pugliese-Ciaccio Hospital's Emergency Department, is the Hub of Emergency Department and the junction between territorial and hospital emergency network. Essential internistic fields in hospitalization (10 accredited beds, divided in sub-intensive and post-critic care) are Advanced Trauma Life Support, Advanced Life Support, Advanced Cardiac Life Support, management of intoxicated patient, Ultrasound in emergency, Non-Invasive Ventilation, the last with particular expertise by the Catanzaro's Medical Staff. A continuous Telemetric Monitoring System allows the surveillance of critical patients.

**Table 2. Activity data: comparison between 3 Operative Units (Cattolica, Colleferro, Catanzaro).**

Operative Unit	Cattolica-Riccione Medicine Unit, AUSL Romagna	Colleferro Medicine Unit ASL RMG	Catanzaro Emergency Unit Pugliese-Ciaccio Hospital
Number of beds	67 Cattolica-Riccione (33 Cattolica)	26	10
Internists	6	8	4
Nurses	21	14	8
Health care assistances	10	2	0
Nurses/Unit	10 beds form	14	8
No. patients discharged/years	1239	1218	901
No. residents	16.9%	38%	28.5%
Total hospitalization days	10,187	9866	4359
Days of average hospitalization	8.2	8.2	4.8
Occupancy bed rate	84.5%	103%	119%
Medium DRG	1.1	1.1	1.1
Emergency (Yes/No)	At Riccione	Yes	Yes
Presence of Surgery Unit	At Riccione	Yes	Yes
<b>Patients' characteristics and types of pancreatitis</b>			
Sex	5 F, 5 M	3 F, 7 M	6 F, 4 M
Medium age	63.9	77.1	59.8
Average comorbidity	2.6	2.5	5.3
Hypertension	20%	80%	40%
Diabetes	40%	30%	20%
Heart failure	30%	30%	50%
COPD	10%	10%	30%
Renal disease	0%	10%	20%
Cerebrovascular/psychiatric disease	20%	20%	50%
Digestive disease	50%	40%	50%
Infections	20%	0	20%
Cancer	20%	20%	20%
Others	20%	0	50%
Multiple comorbidity	70%	60%	100%
<b>Etiology of pancreatitis</b>			
Lithiasic	60%	20%	30%
Alcoholic	20%	40%	40%
Toxic-metabolic	0%	0	10%
Iatrogenic	10%	0	10%
Neoplastic	0%	10%	10%
Idiopathic	10%	30%	0%
Autoimmune	0%	0%	0%
Others	0%	0%	0%
<b>Pathologic of pancreatitis</b>			
Edematous	90%	80%	90%
Necrotic	0%	10%	0%
Necrotic-hemorrhagic	10%	10%	10%
Indeterminate	0%	0%	0%
Complications (specify)	10%: fluid collections, pseudocysts, splenic thrombosis 10%: pneumonia 10%: pneumonia, septic shock	10% fluid collections, pseudocysts 20% pneumonia 10% septic shock	10% pseudocysts + retroperitoneal fluid collections 10% pneumonia, septic shock
Transfer to surgical ward	20%: 10% <i>versus</i> surgical, 10% from surgical	0	20% <i>versus</i> surgical
Death	0%	0%	0%
Pancreatitis-related rehospitalization (within 60 days)	0%	0%	0%

DRG, disease-related group; COPD, chronic obstructive pulmonary disease.

and the APACHE II was not available, intermediate percentage in Cattolica). Transfers in surgery were 10% in Cattolica and 20% in Catanzaro. There were no deaths or readmissions, up to the 60<sup>th</sup> day, for causes related to AP.

With regard to the acceptance phase in FA, the

lower latency in Cattolica (5.3 h vs 8 h in Colleferro, intermediate in Catanzaro).

As for the FA evaluation of the prognostic stratification, C-reactive protein (CRP) is followed in 60% of cases in Cattolica and in 0% in the other two. The percentage of performed hemogasanalysis is low

**Table 3. Prognostic evaluation tools used, in the three Departments and comparative quantitative value of prognostic scores.**

Type of structure	Cattolica-Riccione Medicine Unit, AUSL Romagna	Colleferro Medicine Unit ASL RMG	Catanzaro Emergency Unit Pugliese-Ciaccio Hospital
<b>First aid admissions compared: the diagnostic phase</b>			
Average time spent in FA (h)	5.3	8	6.6
SIRS evaluation in FA	0%	0%	0%
Apache evaluation II in FA	0%	0%	0%
Amylases/lipases in FA	80%	20%	80%
CRP evaluation in FA	60%	0	0%
EGA in FA	20%	30%	0%
Abdomen US in FA	80%	40%	100%
Thorax X-ray in FA	20%	90%	0%
Abdomen US in FA	20%	40%	20%
Consultation in FA	40% (30% surgical, 10% infectious diseases)	70% chirurgic	30% chirurgic
<b>First aid admissions compared: the therapeutic phase</b>			
Hydration in FA	40%	10%	60%
Analgesic in FA (specify)	20% (opiates)	40% (paracetamol)	20% (paracetamol)
Ranitidine/PPI in FA	10%	100%	20%
Antibiotics in FA	0%	50%	0%
Others	0%	100% ECG in FA	90% ECG in FA
Somatostatin	10%	70%	0%
Surgical examination	0%	80%	0%
Transfusion	0%	0	0%
<b>Comparing prognostic stratification in acceptance phase and taking care between three Units</b>			
SIRS evaluation	100%	100%	100%
Score APACHE II <72 h	100%	0	100%
Score APACHE II >72 h	10%	0	40%
CT <72 h	50%	30%	50%
CT >72 h	20%	70%	20%
CT not performed	30%	0	30%
CT severity index	0%	0	0%
Weight or BMI evaluation	100%	0%	70%
Average value of APACHE II in admission	4.5 (0-10)	-	4.0
Lipase average input (discharge)	1923.5 (56.8)	1325.4 (75.2)	1252.4 (245.6)
CRP average input (discharge)	130.23 (10.5)	107.6 (7.2)	232.8 (25.7)

FA, first aid; CRP, C-reactive protein; EGA, hemogasanalysis; US, ultrasound; PPI, proton pump inhibitors; ECG, electrocardiogram; CT, computed tomography; BMI, body mass index.

(30% in Colleferro, 20% Cattolica, 0% in Catanzaro). The chest X-ray is performed in 90% of cases in Colleferro, only in 20% in Cattolica and 0% in Catanzaro. Still on the prognostic stratification, as it is clear from the chart review, apart from the CRP drawn in

Cattolica in 60% of cases, there are no FA evaluations on the APACHE II and SIRS criteria, although a bias of no data transcription is possible.

About diagnostic phases in FA, pancreatic enzymes are required in 80% of cases in Cattolica and

**Table 4. Diagnostic and therapeutic effort in the three wards and summary of compared therapeutic approaches.**

Type of structure	Cattolica-Riccione Medicine Unit, AUSL Romagna	Colleferro Medicine Unit ASL RMG	Catanzaro Emergency Unit Pugliese-Ciaccio Hospital
<b>Diagnostic comparing the three Operative Units (% for patient)</b>			
Evaluation CBC	100%	100%	100%
Evaluation pancreatic necrosis (amylase/lipase)	100% (only lipase)	100%	100%
Evaluation inflammatory markers	100%	100%	100%
Evaluation liver functionality	100%	100%	1000%
Evaluation functionality kidney	100%	100%	100%
Metabolic evaluation (glucose, lipid profile)	100%	100%	100%
PTH, calcium evaluation	20%	0%	10% PTH, 100% calcium
Autoimmunity evaluation	20%	0%	0%
Serological evaluation/culture	30%	40%	10%
EGA	100%	100%	100%
Abdomen US	100%	100%	100%
Thorax X-ray	100%	100%	100%
Abdomen CT	80%	100%	70%
Consultation	30% (chirurgical)	70%	60%
Colangio NMR	30%	0%	20%
Echo-endoscopy	0%	0%	0%
Thorax CT	0%	0%	0%
ERCP	20%	0%	20%
<b>Therapeutic approach compared in the three Operative Units (% for patient)</b>			
Absolute diet/water (average days)	100% (3 days)	60% (4 days)	100% (3.2 days)
Carbohydrate-based diet	100% after possible water-based diet	40%	100% after water-based diet
Nutritional support (whether i.v./enteral)	10% i.v.	30%	20% i.v.
Rehydration therapy	100%	100%	100%
Antibiotics	40% (tazocin 30%, imipenem 10%)	100% (tazocin 30%, imipenem 50%)	40% (rocefin 20%, tazocin 10%, meropenem + levofloxacin 10%)
Somatostatin (specify if for fistula)	0%	70% (after surgical evaluation, no fistula)	0%
Chirurgic examination	0%	80%	60%
Chirurgic intervention	0%	0	0%
Transfusion	10%	0	0%
PPI/ranitidine	Ranitidine 100%	Ranitidine 100%	Ranitidine 100%
Antalgic therapy	90% paracetamol, 10% NSAIDs	80% paracetamol, 20% opiates	100% paracetamol

CBC, complete blood count; PTH, parathyroid hormone; EGA, hemogasanalysis; US, ultrasound; CT, computed tomography; NMR, nuclear magnetic resonance; ERCP, endoscopic retrograde cholangiopancreatography; i.v., intravenous; PPI, proton pump inhibitors; NSAIDs, non-steroidal anti-inflammatory drugs.

**Table 5. Direct costs of diagnosis and treatment in the three structures.**

Type of structure	Cattolica-Riccione Medicine Unit, AUSL Romagna	Colleferro Medicine Unit ASL RMG	Catanzaro Emergency Unit Pugliese-Ciaccio Hospital
<b>Direct costs in comparison of laboratory tests</b>			
Days average stay	10	12.1	4.9 (in Medicine) 6.5 (considering hospitalization in Surgery)
CBC total cost/average (EUR)	276/27.6 (16-60)	247/24.7 (15-55)	119.2/11.92
Amylases total/average (EUR)	0	90.30/9.03 (3-21)	51.2/5.12
Lipases total/average (EUR)	236/23.6 (16-56)	146.40/14.6 (11.40-18.30)	92.8/9.28
CRP total/average (EUR)	293/29.3 (15-75)	198/19.8 (11-22)	142.5/14.25
Total blood gas analysis/medium (EUR)	256.15/25.16 (15.05-60.2)	446.40/44.6 (37.2-55.8)	232.73/23.27
Bilirubin total (direct-indirect) total/average (EUR)	94/9.4 (2-24)	64/6.4 (8-12)	85/8.5
GGT total/average (EUR)	68/6.8 (0-16)	48/4.8 (3-9)	48.51/4.85
Alkaline phosphatase total/average (EUR)	66/6.6 (0-16)	33/3.3 (1.8-4.32)	53.76/5.38
Transaminases total/average (EUR)	104/10.4 (4-24)	179.80/18 (11.60-23.2)	74.88/7.49
Blood glucose, blood urea nitrogen, creatinine, electrolytes total/average (EUR)	384.2/38.42 (26-100)	564/56.4(39-91)	290.44/29.04
Screening coagulation total/average (EUR)	174/17.4 (6-81)	234/23.4 (14.5-29)	104.2/10.42
Other total/average (EUR)	531.45/53.14	526/52.6	457.44/45.74
Total cost blood tests/average cost blood tests (EUR) (range)	2482.8/248.28 (126-499)	2776.9/277.69 (135-554)	1752.66/175.27 (130.31-299.37)
<b>Direct costs comparison between the three Operative Units in diagnostic imaging*</b>			
Thorax X-ray total/average (EUR)	296.58/29.66 (18.6-93)	321/32 (17-71)	256.50/25.65
Abdomen US total/average (EUR)	664.95/66.49 (60.45-120.9)	572/57.2 (44-88)	1025.55/102.55
Abdomen CT with contrast medium total/average (EUR)	1053.6/105.36 (175.6-351.2)	2210/221	1165.15/116.51
Abdomen MRI total/average (EUR)	480.3/48.03 (0-160.10)	0	320.20/32.2
ERCP sphincterotomy + removal calculations total/average (EUR)	2172.48/217.25 (0-1086.24)	1655/165.5	1612.52/161.25 (01086.24)
Consultations total/average (EUR)	138/13.8 (23-46)	210/21	138.00/13.8 (0-23)
Central venous catheter insertion total/average (EUR)	284.9/28.48 (0-284.9)	0	0
Others	35.42	273/27.3	153.60
Total cost instrumental tests/average cost instrumental tests (EUR)	5126.23/512.62	5241/524.1	4671.52/467.15
<b>Direct costs of treatment compared between the three Operative Units°</b>			
Cost hydrating therapy total/medium range (EUR)	89.8/8.98 (2-20.16)	28/2.8 (1.40-4)	120.60/12.06 (8.76-16.28)
Cost parenteral nutrition/enteral (EUR)	207.46/20.74 (0-207.46)	1520/152 (0-285)	742.68/74.27 (0-495.12)
Cost antibiotic tot/average (EUR)	411.24/41.12 (0-154.14)	1274/127.4 (0-420)	9808.81/980.88 (0-9242.94)
Total cost transfusion/average (EUR)	306/30.6 (0-306)	0	0
Cost gastric protection (ranitidine) (EUR)	39.35/3.93 (2.07-5.85)	64.40/6.4 (2-10.8)	20.87/2.09 (1.40-3.15)
Surgical examination cost (EUR)	0	332/33	0
Somatostatin (EUR)	0	1800/180	0
Analgesics (EUR)	173.35/17.33 (1.99-59.49)	162/16.2	138.57/13.86 (8.94-17.88)
Other (EUR)	-	-	-
Total cost of therapy/medium (EUR)	1227.2/122.7	5180/518	10831.53/1083.15

To be continued on next page

Catanzaro (20% in Colleferro), while abdominal ultrasound has been performed in a high percentage of cases in Cattolica and Catanzaro (80% and 100% vs 40% in Colleferro). Abdominal CT (which should not be required prior to 72 h, not to worsen a possible pancreatic necrosis) is not practiced in FA in a low percentage of cases (20% Cattolica, 30% Catanzaro, 0% Colleferro). Expert advice (mostly surgical) was requested in 30% of cases in Catanzaro, 40% in Cattolica and 70% in Colleferro.

As regards the therapeutic phase in FA, hydration should be implemented (10% in Colleferro, 40% in Cattolica, 60% in Catanzaro); analgesic consumption is not high (20 to 40%, more in Colleferro), probably for the persistent prejudice that the opioid analgesic affects the diagnosis, despite a recent Cochrane review.<sup>11</sup> Although

not in a high percentage of cases, in FA are practiced antibiotic therapy (50% in Colleferro) and somatostatin (10% in Cattolica, 70% in Colleferro), which are advisable, according to the recent guidelines, only in local complications (fistula/pseudocyst).<sup>12</sup>

Regarding the prognostic and diagnostic phase in OU, after taking care, the APACHE II score early (first 72 h) is practiced in Cattolica and Catanzaro, so as the SIRS evaluation, which is, alone, always practiced in Colleferro. However, no CT severity index was applied in any OU. In Cattolica and Catanzaro, contrast-enhanced abdominal CT scan is performed prior to 72 h in 50% of cases, although guidelines recommend, if not in specific circumstances, to perform it later, not to aggravate a possible pancreatic necrosis. Colleferro in this respect, has proved to be more virtuous.

**Table 5. Continued from previous page.**

Direct costs of the human resources in comparison among the three Operative Units <sup>†</sup>			
Medical cost (total/average) (EUR)	1164.4/116.44 (92.3-184.6)	1668/166.8 (130/322.5)	585.40/58.54 (46.15-92.30)
Nursing cost (total/average) (EUR)	790.4/79.4 (44.8-121.6)	840/84 (60-120)	302.40/30.24 (22.40-44.80)
Support staff cost (total/average) (EUR)	442.5/44.25 (20-87.5)	400/40 (20/80)	135.00/13.50 (10.00-20.00)
Total cost (Medical+Nursing+Support Staff)	2397.3	2908	1022.80
Average cost/patient	239.73	290.8	102.28
Costs and revenues of hospitalizations for acute pancreatitis compared in the three Operative Units			
Average DRG	1.12 (1.0518-1.6432)	1.1 (1.058-1.6432)	1.11 (1.0518-1.6432)
Direct average cost of hospitalization (EUR)	1123.32	1610.59	1825.82 (393.39-10,718.66)
Average cost of admission (direct + indirect + basic) (EUR)	1123.32 + 961.21 + 2000 = 4084.53	1610.59 + 935.34 + 2420 = 4965.93	-
The average sales price of admission (EUR)	3028.47 (2745.49-3377.95)	2775	3001.43

CBC, complete blood count; CRP, C-reactive protein; GGT, gamma glutamyltransferase; US, ultrasound; CT, computed tomography; MRI, magnetic resonance imaging; ERCP, endoscopic retrograde cholangiopancreatography; DRG, disease-related group. <sup>\*</sup>Cost of diagnostics: derived from the latest version of the regional *tariffario*; <sup>†</sup>cost of treatment: taken from the hospital pharmacy management and control; <sup>‡</sup>costs of playing time human resources provided by the management control.

**Table 6. Cost/income and break even point compared.**

	Cattolica-Riccione Medicine Unit, AUSL Romagna	Colleferro Medicine Unit ASL RMG	Catanzaro Emergency Unit Pugliese-Ciaccio Hospital
A. Rate for DRG	3028.47	3195.00	3001.43
B. Cost diagnostic and therapeutic procedures for admission	883.60	1868.93	1725.57
C. Personnel costs (medical, sanitary, technical) for admission	239.73	518	102.28
D. (B+C) Total direct costs for hospitalization	1123.33	2386.93	1827.85
E. (A-D) Residual income	1905.14	808.07	1173.58
F. Daily indirect costs (cost bed general)	200	200	200
G. (E/F) Days in hospital for hospitalization in balance	9.53 vs 10 days	4.04 vs 12.1 days	5.87 vs 4.9 days

DRG, disease-related group.



About the nutritional support, in almost all cases in Cattolica and Catanzaro, for at least three days, the patient is rehydrated and then fed carbohydrate diet, while only in 60% of cases at Colleferro. The concept is implementable, since the light carbohydrate diet, according to the most recent guidelines, is recommended just disappears pain and improve inflammation indices.<sup>1,2</sup> Total nutritional support has been practiced in few cases, in 10-30% of them it has always been parenteral and never enteral.

Other two points are perfectible: the use of somatostatin in 70% of cases in Colleferro (after surgical consultation) and the use of antibiotics. The use of antibiotics other than those penetrating pancreatic necrosis can be justified by extrapancreatic complications, however, their use is excessive (100% of cases) in Colleferro, where, in any case, such complication occurs more frequently. Finally we report the widespread use of hydration, analgesics and ranitidine.

Through the analysis of the collected information, the latest macrophase sets the next goal to measure and compare the economic output of the three Units, through the analysis of economic processes, diagnostic and therapeutic procedures, so as to identify those, which determine the lower consumption of resources.

As regards the economic data, multiple differences are observed among the three OUs.

In all OUs, costs are lower than reported in literature (about 10,000 € per patient),<sup>13-15</sup> however, it is observed a large variability range (the overall average direct cost for patient with AP varies from € 1123.32 of Cattolica to € 1610.59 in Colleferro, and € 1825.82 in Catanzaro, where the average age is lower, but there are multiple comorbidities).

The costs distribution varies greatly. In Cattolica and Colleferro the brunt consists in the instrumental test (as justified by predominantly lithiasic etiology in Cattolica and mixed in Colleferro, with therapeutic endoscopic retrograde cholangiopancreatography). The average weight of examinations, in Cattolica, is in fact € 760.9 (€ 512.62 for diagnostic imaging, € 248.28 for laboratory diagnostics, € 239.73 for human resources and € 122.7 for therapy). In summary, the weight of diagnostics is equal to about 6 times the therapy. Even in Colleferro, resources are mainly absorbed by the diagnostic phase (€ 801.79 in total, of which € 524.1 for laboratory examinations and € 277.69 for blood tests), followed by therapy (€ 518), while the minor costs are absorbed by human resources (€ 290.8). In Catanzaro, however, most resources are absorbed by drug treatment (€ 1083.15), followed by the diagnostic phase (€ 766.95, of which € 467.15 for diagnostic imaging, € 299.37 for blood tests) and, finally, human resources (€ 102.28).

Minor direct costs are those of Cattolica Medicine Unit (€ 1123.32 vs € 1610.59 in Colleferro and €

1825.82 in Catanzaro). However, if we consider the average total costs of hospitalization (resulting from an abstraction, direct costs + basic, according to a previous study<sup>16</sup> on sepsis including these OUs) we find the better resources consumption in Catanzaro (probably due to lower indirect costs related to a shorter duration of hospital stay in Emergency Medicine).

### Identifying solutions, corrective actions and implementation

Examined data confirm that a significant issue is given by the *reduction of latency time diagnostics*, without affecting, however, the *diagnostic appropriateness*. This aspect definitely needs corrective action, because, as literature data confirm, it influences clinical and economic outcomes.

In fact, there is increasing evidence that early and appropriate management can improve final results.<sup>1,2</sup>

The goal can be achieved by a reduction of waiting times in the Emergency Room (ER) where, in our reality, prognostic stratifications are performed unfrequently, sometimes diagnoses are made without the Atlanta criteria and, sometimes, tests (such as abdominal CT) are performed with inappropriate timing.

The goal can be achieved in Colleferro (average stay in the ER: 8 h, vs 6.6 h in Catanzaro and 5.3 h in Cattolica).

### Possible ways of implementation

Possible ways of implementation may be:

- *Creation of a dedicated team* (as in some Sepsis Centers) consisting of internist, radiologist, surgeon, anesthetist, nurse (difficult solution in a period of deficiency in human resources).
- The doctors of Medicine Unit might ensure earlier patient's admission (a sort of *fast track*) for patients with AP.
- Selection of a dedicated Internist, who could provide advice in case of access to the ER (in order to speed up the diagnostic and therapeutic procedure within a dedicated preferential path).
- *Greater professional exchange through*: acts of implementation in involved OUs and in ER, e.g., audit, care pathway (PDTA), training.

In this regard, the Cattolica OU, at the time of observation, was working on Riccione-Cattolica Hospital PDTA, then extended to Rimini Local Health Unit.

The partial sharing of human resources between ER and Emergency Medicine facilitates implementation acts in Catanzaro.

Such actions would also implement the diagnostic appropriateness.

In fact, in this regard, as for the timing of abdomen CT scans, Colleferro Medicine proved to be the most virtuous; however, although CT was mainly per-

formed according to the timing of guidelines, in 40% of cases we observed inadequate radiological responses to clinical questions (insufficient description of pancreatic area), probably due to the telematic reporting, without prior direct contact between internist/ER doctor and radiologist.

In Cattolica, instead, the problems are the CT scans performed in the ER and Surgery, where 20% of patients have been under observation before admission.

Both situations could find benefit from greater inter-professional comparison, *promoted by meetings and PDTA*.

Similarly, we might define a *checklist*, to facilitate the processes of identification, risk stratification, activation of interventions, PDTA, standardized procedures to request laboratory tests (*AP panel*).

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## Treatment appropriateness

Perfectible points are:

- Use of somatostatin in 70% of cases in Colferro, regardless of complications.
- Use of antibiotic therapy: the use of antibiotics other than those penetrating pancreatic necrosis (carbapenems, quinolones, metronidazole) can be justified by extrapancreatic complications, but antibiotics are given in 100% of cases in the OUs where the worst complications are recorded.
- The absolute/water-based diet is consistently applied in the three OUs in the first 3-4 days; currently, Guidelines suggest starting a light carb diet as soon as inflammation indices are improved and pain is resolved.

Likewise, in all three OUs the artificial feeding is intravenous (i.v.), while guidelines suggest enteral feeding, unless this is poorly tolerated.<sup>1,2</sup>

We believe that all the three aspects can be implemented by PDTA, which also determine a greater professional exchange within the Hospital.

## Ways of implementation

By PDTA we might implement:

- An empirical antibiotic treatment protocol, related to *scores*, taking account of specific local conditions (contextualization and local share).
- The early introduction of a light-carb diet, preferring enteral approach to i.v. approach.
- The inter-professional spread of the information concerning somatostatin, with the relative level of evidence.

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## Appropriateness of the setting of admission

In our records, it has not turned out to be something relevant, given the absence of mortality and the

transfer to surgery of only 20% of patients in Cattolica and 20% of patients in Catanzaro.

Despite the *bias* represented by our small sample, we believe this problem to be quite relevant in everyday reality.

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## Application of prognostic scores of seriousness

We believe that the management of patients with AP is affected by their latency in the ER, but also by the poor implementation in the ER of prognostic clinical assessment, necessary to address the patient to the right setting and therapy.

Also in this respect, it seems useful to create PDTA suitable to the local context.

One element is the identification of the clinical complexity for the obvious correlation between clinical complexity and mortality-complications (objective achievable by the three OUs): although the latter, in fact, are lower in all 3 OUs compared to literature,<sup>17</sup> in the OU where comorbidities are greater, greater are also the complications (Cattolica/Catanzaro).

We therefore need to apply gravity scores, to be implemented not only in the ward (both at the entrance and during hospitalization, and, for some scores, when the discharge is scheduled), but also in the ER, in order to address all patients with higher score to the Intensive Care Unit (ICU) or to surgery.

The diversification of health care depending on patients' features, in fact, must take into account the two basic variables that should be monitored in every model of health care: the clinical and health care complexity of patients, variables that do not always coincide.

## Ways of implementation

In the reality of large ER area, the implementation of scores is part of the computerized medical record, for instance, the evaluation of scores SIRS and APACHE II is integrated in medical records and in the alert, a process, however, that still does not concern the ER.

The implementation of scores of seriousness (MEWS, SOFA, APACHE II, SIRS, CT severity index), not only in the Ward, but also in the ER, could be practiced with specific business PDTA and reminders entrusted to the staff or posted on the bulletin board.

The *scores* are certainly not to be seen as substitutes, but as complementary to clinical evaluation and as aid for the systematic *automated* evaluation of the major prognostic benchmarks.

In this regard, also in the intensive care project, the reorganization of the OU for complex patients could fulfil this objective, especially in small *Spoke* hospitals, lacking in ICU.

## Reduction of costs employed for the admission of patients with acute pancreatitis

*Reduction of costs employed by human resources:* cost not overwhelming, but still relevant in Cattolica and Colferro, where furthermore there is a major number of human resources.

However, we do not believe that this factor is implementable because: the calculation of minutes is subjective; the Catanzaro OU, while having a less numerous staff, has, however an organization of rounds and health-care by Emergency Medicine.

Moreover, the weight of human resources is directly related to the seriousness of the cases (it increases, for example, in case of septic shock or complications); in the end, the literature concerning the organizational implementing measures for the management of acute pancreatitis involves attention to patient monitoring and care that, in turn, would be responsible for a further increase in this cost category.

*Reduction of costs employed by blood tests* (objective achievable in all three OUs, especially in Colferro and Cattolica): the variable is not easily manageable, as changing in relation to patient complexity and because a reduction in the number of tests might result in false negative diagnoses and, secondarily, in complications, with further increase in costs and length of hospitalization.

The same daily application of some *scores* increases such costs.

However, the optimization of blood tests is achievable also by the use of the *alert* in computerized medical records.

*Reduction of costs employed by therapy* (objective achievable by the UO in Catanzaro and, partially, in Colferro): such variable is related to the divergence of regional price lists and to the type of complications and comorbidities, however, it can be implemented by critical and retrospective analysis.

*Reduction of costs employed by instrumental tests* (objective achievable by the OU of Colferro and Cattolica): the same applies to laboratory diagnostics.

In this case, you must also consider the waiting period of the Cost Centers, which acquires special regional and business value.

We must specify that the measures of economic implementation are valid in view of a continuous improvement, however, even if in view of their high variability, basically all three OUs have lower costs for hospitalization of patients with acute pancreatitis, compared to literature.<sup>13-15</sup>

Undoubtedly, the diversification of health care depending on the characteristics of patients seemed mandatory, considering the two basic variables to keep monitored in each nursing model: the clinical com-

plexity and the nursing complexity of patients, variables that do not always coincide.

### Ways of implementation for diagnostics

Ways of implementation for diagnostics are:

- *Clinical audits, which verify the appropriateness of tests:* In the Emilia Romagna region area, periodic reports are sent about it, although focused on the number of samples, rather than on their appropriateness, while internal checks of the OU could lead to a more effective implementation.
- *Dedicated paths* for patients with acute pancreatitis, which, as in the Toyota method, include the scheduling of daily test, without overlaps. Obviously, the complications and comorbidities sometimes make the actual scheduling poorly predictable.
- Use of *alerts* to avoid redundant tests, implementation promoted in the OU of Cattolica by using a computerized clinical chart.

### Ways of implementation for the therapy

Ways of implementation for the therapy are:

- *Internal audits* focused on the appropriateness of the antibiotic therapy.
- In-depth analysis of the external qualitative and quantitative *Benchmarking*.
- Periodic reports provided by the pharmacy (often more focused on a quantitative than qualitative approach).

As further proof of that, a calculation of the cost-benefit difference (Table 6) for hospitalization for acute pancreatitis compared to basic hospitalization and of break even point (BEP) has shown that the hospitalization for acute pancreatitis actually involves an average loss of about € 1203.49 (ranging between € 1056.06 of Cattolica, and € 1350.93 of Colferro - see the following paragraph *Note*) and that the BEP now is not reached.

The reaching of the BEP would require an average stay of about 6.48 days, which is not in literature (14 days)<sup>17</sup> and that could be attainable only in emergency medicine, from where the patient can be transferred, as soon as he is stabilized.

### Note

The total cost (direct for admission for acute pancreatitis + direct for basic admission + indirect) was calculated by taking data from the SNOOPY Study for basic hospitalization in the Medicine Unit of Cattolica and Colferro. For the Emergency Medicine of Catanzaro we only used direct data concerning hospitalization for acute pancreatitis, and therefore the loss (cost-revenue) was not specified, because it would be rough.

## Conclusions

With this work, we set out to use *benchmarking* to improve quality standards in the management of patients with AP, optimizing the diagnostic-therapeutic path, from admission to hospital until discharge, through the comparison between different procedures.

Through the analysis of the collected information, we have identified and measured the differences in the clinical management of the diagnostic - therapeutic workup for AP in the three OUs.

In the three OUs, almost all patients had at least one comorbidity, often multiple, expression of the complexity of the internist patient.

Patients had an APACHE II not indicative of seriousness at admittance, almost identical in the three groups, and anyway <7, expression of complex patients, but not, apparently, at high risk of clinical deterioration.

In all three OUs, complications and mortality were below literature.

In particular, only 0-20% of patients were transferred to Surgery or to another OU and complications were equal to 20/40%. Both mortality and readmissions after 60 days were equal to 0%.

Significantly different was the waiting time in the ER in the three realities. We believe that this longer waiting time can contribute to worsen the final outcome, in terms of complications.

As for economic data, in all three OUs, costs were lower than those reported in literature,<sup>13-15</sup> with a prevalence of costs for therapeutic resources in Emergency Medicine and for diagnostic resources in the Medical Ward of Cattolica and Colferro.

In our opinion, moreover, the application of scores of seriousness, although not being a substitute but an integration to clinical evaluation, is to be implemented not only in OU, but also in the ER, in order to address to ICU or to Surgery all the patients with higher score.

Another aid can be provided by the integration of scores in the computerized medical record, by regular audits and creation of dedicated staff to promote PDTA and a professional exchange.

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