SDA Bocconi SCHOOL OF MANAGEMENT

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ECONOMIC IMPACT OF A MORE EXTENSIVE USE OF FENO TESTING ON THE ITALIAN POPULATION WITH ASTHMA

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"The aim of this study was to estimate the overall economic impact of an extensive use of FENO testing on the Italian population with asthma, including extra costs of testing and savings generated by more appropriate prescriptions, increased adherence and lower frequency of exacerbations"

Introduction e Background

Asthma is a **chronic inflammatory airway disease** that affected about 262 million people in 2019 and caused 461000 deaths around the world [1].
Standard of care consists in various **follow up visits** where a chest examination and spirometry are commonly performed in order to find the best management plan and monitor asthma [2].
Exhaled nitric oxide is a direct signal of the Type-2 mediated, pro-inflammatory cytokine mechanisms of central importance in the pathophysiology of Type-2 airway inflammation [3-5].
Fractional exhaled nitric oxide (FeNO) is a noninvasive, point-of-care, easily performed **biomarker of airway inflammation** used in both the assessment and management of asthma, as it is strongly associated with type 2 inflammation [5].

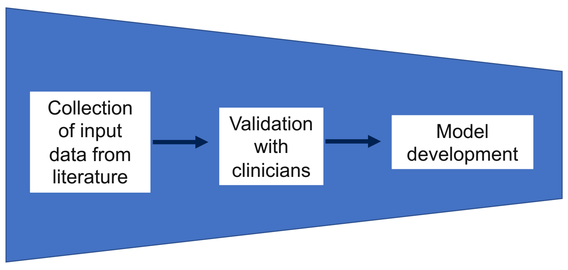
The use of FeNO test is related to outcomes such as:

- Reduction in inhaled corticosteroids (ICS) dose [6]
- Reduction in asthma exacerbations [7-8]
- Reduction of the risk of hospitalization for severe exacerbation [7-8]

Studying the specific type of patient's airways inflammation can help doctors making the right diagnosis, find the best management plan and better monitor asthma. Indeed, high **FeNO** predicts risk of exacerbations and lung function decline, so the use of the **test could help physicians in better managing patients and controlling the disease.**

Methods

The method used for conducting the study is tripartite.



The model, developed in MSExcel, considers **different aspects of the management of patients with asthma:**
1. Visits/exams
2. Exacerbations (non severe, severe requiring an hospitalization)
3. Drugs (inhaled corticosteroids/combinations and other treatments)
4. Management of adverse events caused by the use of short-term oral corticosteroids

Clinical **inputs** were **validated by expert clinicians** during an Advisory Board (14 April 2022)

A cost of illness (COI) analysis [9] was performed to describe the different types of costs related to asthma in the Italian population. The objective of the COI analysis was firstly to **estimate the yearly economic burden from the Healthcare Service perspective in Italy of the management of asthmatic patients** according to **standard of care (SOC)** that refers to the application of the most recent GINA guidelines; secondly, we evaluated the **changes in the economic burden of managing these patients considering the introduction in clinical practice of FeNO testing**.

Analyses

Epidemiological data
The analysis considered the current Italian population [10] to which an asthma prevalence of 6.60% has been applied [11]. Considering a mortality of 434 asthma patients per year, the considered population of Italian asthmatic patients was composed by 3,909,590 patients.

Efficacy of FeNO testing
The literature reports different randomized controlled trials (RCTs) comparing FeNO testing with standard of care for the management of patients with moderate to severe asthma and these studies highlighted the benefits of FeNO testing.

Reduction in inhaled corticosteroids (ICS)
- 42%
- Assumed reduction in dose is reflected into a reduction in cost
- The reference study considers visits every 3 month (standard use)

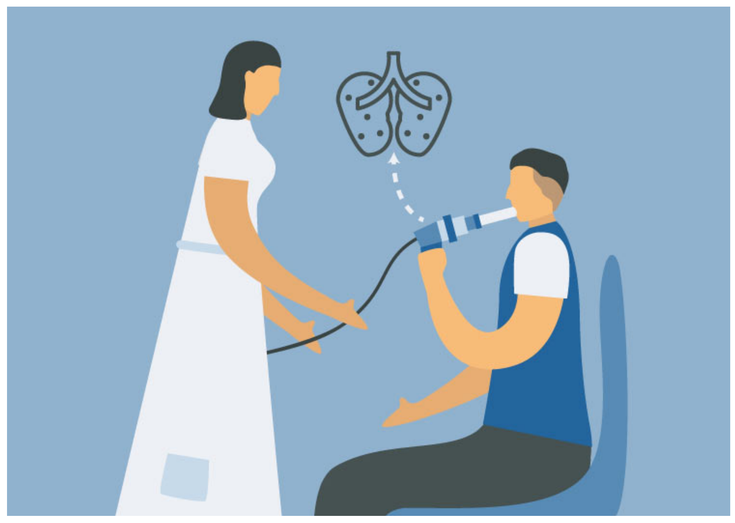
Reduction in asthma exacerbations
- 29%
- The reference study considers visits every 3 month (standard use)

Reduction of the risk of hospitalization for severe exacerbation.
- 83%
- The reference study considers 9 visits/year (standard use), about every 1.5 months

Healthcare resource use and frequency of events
For SOC we considered one specialist visit every 6 months during which a spirometry is performed and pharmacological therapy recommended. For FeNO strategy the same assumptions were considered, with the inclusion of the test. The KOLs stated that a follow-up time shorter than 6 months between two visits did not represent the clinical practice in Italy. In case of asthma exacerbation (severe or non-severe) it was assumed that patients are administered a short course of oral corticosteroids according to GINA guidelines. Corticosteroids may increase the risk of serious acute complications. In the model we referred to the literature [12] reporting the incidence rates (per person year at risk) of few adverse events.

Costs
For specialist visit, spirometry and FeNO test, we applied the National reimbursement tariffs for outpatients' services. For hospitalizations due to serious exacerbation we applied the DRG tariffs.
The cost for the management of a non-serious exacerbation was retrieved from a recent Italian study.
The cost for the management of adverse events following short course of oral corticosteroids was retrieved from economic evaluation studies related to the Italian context [13–15].

THE IMPORTANCE OF FENO TESTING



Results

Cost Category	Strategy SOC	Strategy FE_{NO}	Difference %
Exacerbations			
Hospitalizations for serious exacerbations	31,648,508 €	5,380,246 €	-83%
Management of non-serious exacerbations	168,976,433 €	119,973,268 €	-29%
Total exacerbations	200,624,942 €	125,353,514 €	-38%
Treatments			
Corticosteroids for inhalation and combinations	663,200,000 €	384,656,000 €	-42%
Other drugs	317,500,000 €	317,500,000 €	0%
Total treatments	980,700,000 €	702,156,000 €	-28%
Management of adverse events			
Sepsis	28,485,156 €	19,748,806 €	-31%
Venous thromboembolism	3,812,104 €	2,642,938 €	-31%
Fractures	71,282,080 €	49,419,985 €	-31%
Total management of adverse events	103,579,340 €	71,811,729 €	-31%
Visits			
Total cost for visits	126,663,687 €	126,663,687 €	0%
Total cost for spirometries	187,649,907 €	187,649,907 €	0%
FE_{NO} test	0 €	181,394,910 €	100%
Total visits	314,313,594 €	495,708,504 €	58%
OVERALL TOTAL	1,599,217,876 €	1,395,029,747 €	-13%

Table 1 - Costs detail for the different categories

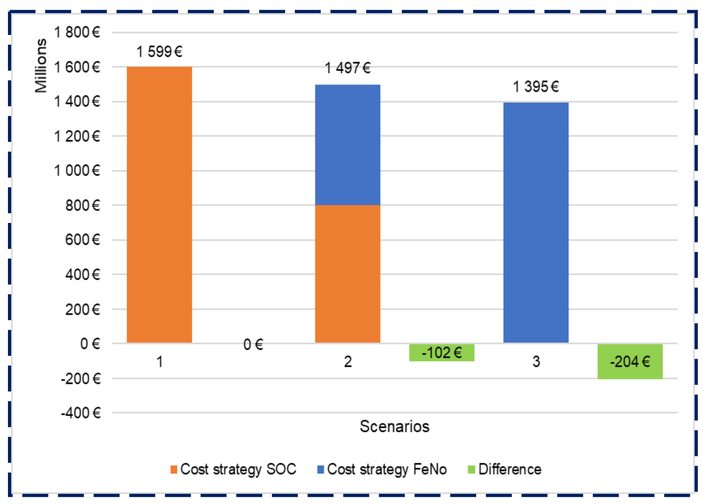


Figure 1 - Costs for the different scenarios considered (1: 100% SOC, 2: 50% SOC and 50% FENO testing, 3: 100% FENO testing). Differences are related to the comparison versus scenario 1.

For **SOC scenario**, all the cost components lead to a **total yearly cost for the management of patients with asthma in Italy of 1,599,217,876€** that translates into **409.07 € per patient.**

For the scenario which considers the use of **FeNO** testing in the clinical practice**, total cost per year for the management of patients is 1,395,029,747€** that corresponds to **356.84€ per patient.**

Standard of care
- Total cost **1,599,217,876 €**
- Cost per pt **409.07 €**

FeNO testing
- Total cost **1,395,029,747 €**
- Cost per pt **356.84 €**

Conclusions

The present study estimated the overall economic impact of an extensive use of FeNO testing in the Italian population, and compared it to the management of patients according to SOC. In the baseline analysis, **an increased utilization rate of FeNO testing from 50% to 100% of patients may lead to savings for the NHS from about 102 to 204 million € compared to the management of patients with SOC.** Considering an increased frequency of visits (every 3 months instead of 6 months) the savings would become about 11 and 23 million € in the two considered scenarios, respectively.

The present study provided a detailed analysis of the different categories to assess the cost for the management of Italian patients with asthma with SOC or with an increased utilization of FeNO testing. **The study showed the advantages of FeNO testing for the optimization of the treatment for patients**, but also highlighted the lack of detailed data for few cost items (e.g., consumption of biologics for asthma) to perform more specific analyses.

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