Evaluating Colombia's Health Insurers Efficiency in Lung Cancer Management: a Data Envelopment Analysis

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INTRODUCTION

Among the main mortality causes, cancer remains on the spotlight (1). Moreover, it is in second place amidst major causes of Disability Adjusted Life Years (DALY) and (2). Out of all cancer types, lung cancer stands between the top 10 health burdens (3) and reaches up to 4 times the per capita cost of a person without cancer (4,5). During 2020 in Colombia, 293 thousand cases and 54 thousand deaths with lung cancer sitting second in most deaths by cancer type (6,7). As in the international context, in Colombia cancer shows up as a one of the diseases with highest economic toll (8). Lung cancer reached an 8.5 thousand per capita dollar cost and 22.7 million dollar for the country in 2004 (2004 dollars) (9). The economic and health burden lung cancer imposes, highlights the need for an efficient resource use and its evaluation (10-24).

OBJECTIVE

This study measures and analyzes Colombian health insurer's efficiency in lung cancer management in 2020. These results are compared against therapeutic goals' accomplishment to provide a picture between insurer's efficiency and effectiveness.

METHODS

Administrative records of cancer population provided by insurers to Colombia's High Cost Diseases Fund (*Cuenta de Alto Costo – CAC*) between January 2, 2020, and January 1, 2021, were used to build cancer health risk management indicators for each insurer from third payer and state regimes. Enrolled population to each insurer on January 1, 2021, was calculated from the official unique enrollee database (*Base de Datos Única de Afiliados – BDUA*) of Colombia's Health Ministry (*Ministerio de Salud y Protección Social – MinSalud*). Inputs (*m*) and outputs (*s*) are divided between desirable and discretionary (*dd*), non-controllable (*nc*), undesirable but discretionary (*udd*), and desirable but non-discretionary (*nd*). Theses were selected from CAC's lung cancer health risk indicators consensus and lung cancer risk sharing mechanism in Colombia (25-27). Efficiency scores were obtained using Data Envelopment Analysis (28) and efficient insurer's indicators were compared to Colombia's lung cancer consensus to assess effectiveness in therapeutic goals accomplishment. Inputs included diagnosis and treatment wait times (*dxtwt* and *ttotwt*, respectively), as well as enrolled population (*%pob*). On the other hand, outputs included proportions of enrollees: detected early (*eardet*); receiving curative treatment (*curtto*); with systemic treatment (*systto*); and, in remission (*rem*). Mortality and lethality rates (*mort* and *letha*, respectively) together with prevalence (*preva*) were also added as outputs. Lastly, a Tobit regression is used to assess the relation between efficiency scores and proportion of population belonging to key population (e.g., sex workers), with a second primary cancer or belonging to minorities (29,30). All calculations were executed in R (31).

Equation 1 DEA model – first stage (technical efficiency)

$$\max_{\eta_o,\mu} \eta_o \quad \forall o = \{Insurer \mid Insurer = 1, \dots, 37\}$$
$$subject\ to$$
$$x_{o,mdd} \geq \mu X_{mdd} \quad \forall mdd = \{dxtwt, ttotwt\}$$
$$x_{o,mnc} = \mu X_{mnc} \quad \forall mnc = \{\%pob\}$$
$$\eta_o y_{o,sdd} \leq \mu Y_{sdd} \quad \forall sdd = \{eardet, curtto, systto, rem\}$$
$$\eta_o y_{o,sudd} \leq \mu Y_{sudd} \quad \forall sudd = \{mort, letha\}$$
$$y_{o,sdnd} \leq \mu Y_{sdnd} \quad \forall sdnd = \{preva\}$$
$$\mu \geq 0$$

Equation 2 DEA model – second stage (mix efficiency/slacks)

$$\min_{t_{o,mdd}^-, t_{o,mnc}^-, t_{o,sdd}^+, t_{o,sudd}^+, t_{o,dnd}^+} -t_{o,mdd}^- - t_{o,mnc}^- - t_{o,sdd}^+ - t_{o,sudd}^+ - t_{o,dnd}^+$$
$$\forall o = \{Insurer \mid Insurer = 1, \dots, 37\}$$
$$subject\ to$$
$$x_{o,mdd} - \mu X_{mdd} - t_{o,mdd}^- = 0 \quad \forall mdd = \{dxtwt, ttotwt\}$$
$$x_{o,mnc} - \mu X_{mnc} - t_{o,mnc}^- = 0 \quad \forall mnc = \{\%pob\}$$
$$\eta_o^* y_{o,sdd} - \mu Y_{sdd} + t_{o,sdd}^+ = 0 \quad \forall sdd = \{eardet, curtto, systto, rem\}$$
$$\eta_o^* y_{o,sudd} - \mu Y_{sudd} + t_{o,sudd}^+ = 0 \quad \forall sudd = \{mort, letha\}$$
$$y_{o,sdnd} - \mu Y_{sdnd} + t_{o,sdnd}^+ = 0 \quad \forall sdnd = \{preva\}$$
$$\mu \geq 0, t_{o,mdd}^- \geq 0, t_{o,mnc}^- \geq 0, t_{o,sdd}^+ \geq 0, t_{o,sidd}^+ \geq 0, t_{o,sdnd}^+ \geq 0$$

RESULTS

From 37 third payer and state regimes insurers, 24 (65%) were found to be efficient. From the non-efficient insurers 9 belong to the state regime and 4 to the third payer. The indicators with the lowest accomplishment were diagnosis and treatment wait times, along with curative treatment. Even among efficient insurers, none fulfilled all of the therapeutic accomplishment goals.

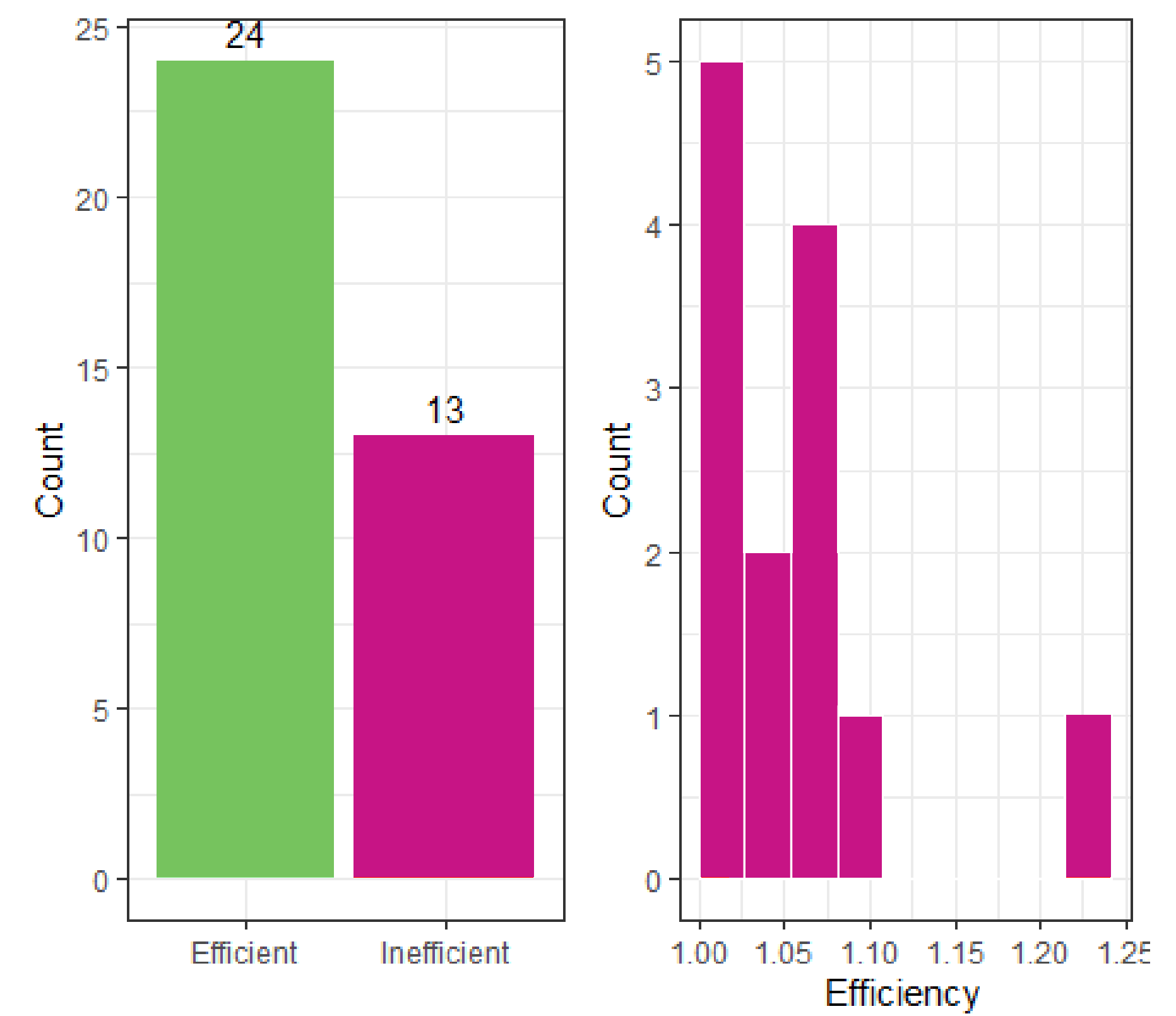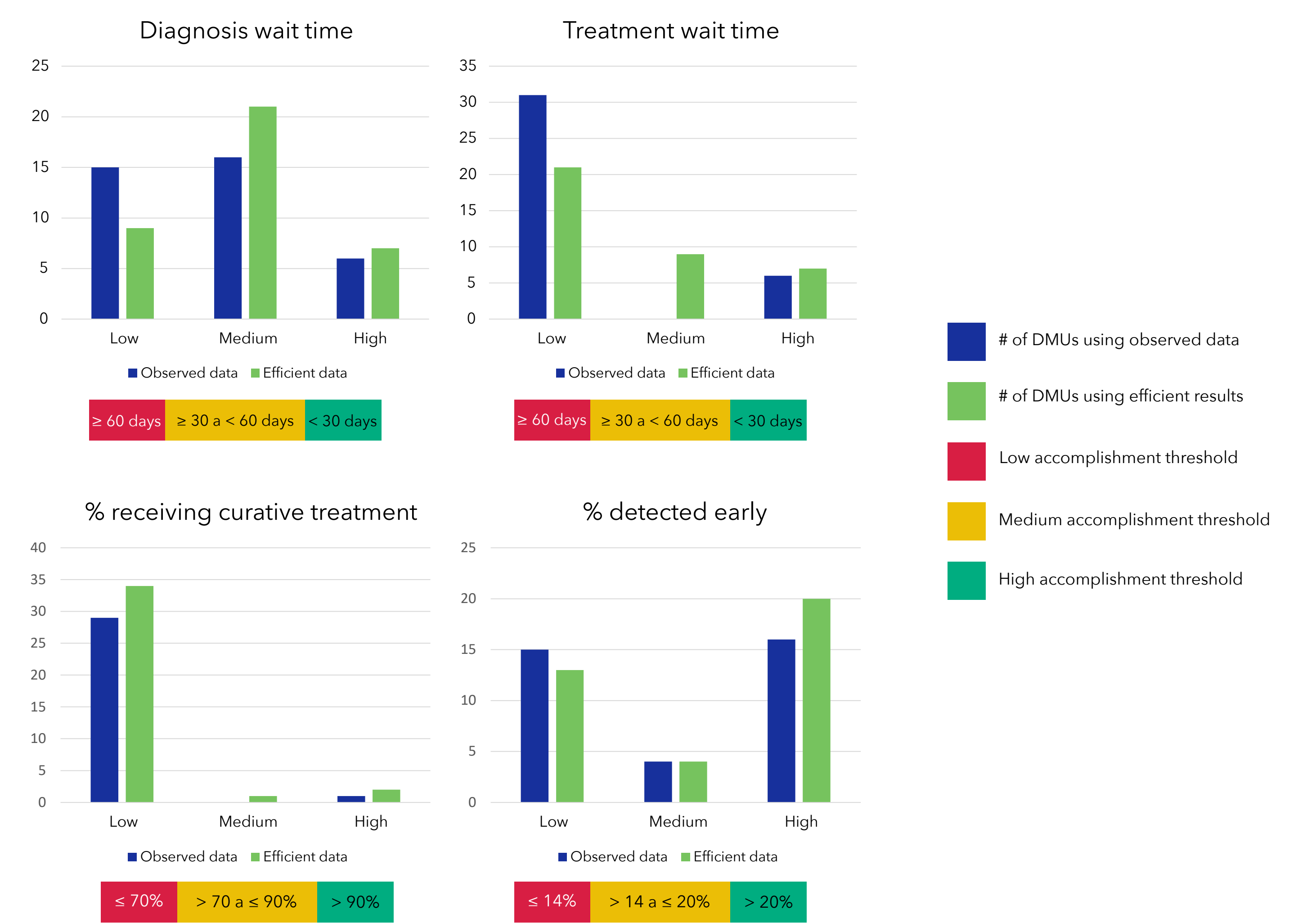**Figure 1 Efficient/Non efficient DMUs and efficiency score distribution**

Figure 2 Number of DMUs by indicators accomplishment levels comparing observed data and DEA's efficient results

DISCUSSION

In general, insurers present similar efficiency scores (except one insurer) with 65% found to be efficient. However, none fulfills all lung cancer consensus accomplishment goals. Differences between efficiency scores among insurers were not explained because of a higher proportion of key population, minorities or second primary cancer. No similar analysis for lung cancer with a physical units focus was found for Colombia, though one was found for stomach cancer (32) and others have been implemented with a different perspective (33-42). This study focuses on the efficiency in the production scale, leaving aside the financial resources and including inputs in physical amounts. Future research for the study includes the use of fuzzy logic and efficiency analysis through time using Malmquist index, as well as results from a financial and mixed perspective.

REFERENCES