

# Impact of using the ASIGNA computer program in a hospital emergency department

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## CONFLICT OF INTEREST:

The authors declare no conflict of interest in relation with the present article.

**Objective:** To determine whether the ASIGNA program for assigning patients to nurse-physician teams expedites time until the initial evaluation of a patient by an emergency physician in the Hospital General Universitario de Elda, Spain.

**Methods:** Nonrandomized study of the effect of using the ASIGNA program from February 2012 to February 2013. The main outcomes were times in minutes until triage and until the initial evaluation by an emergency physician, and the qualitative assessment of compliance or not with times considered reasonable for each color-coded priority category in the Manchester triage system. Secondary variables recorded were sex, age, triage color code, and number of patients waiting. Multivariable linear regression analysis was used to study time between triage and physician evaluation in minutes; logistic regression analysis was used to study the associations with reasonable time according to the Manchester triage system. Indicators of clinical relevance were calculated with 95% confidence intervals (CI).

**Results:** The rates of correctly performed triage increased from 68.2% to 90.6% with use of the ASIGNA program ( $P<.001$ ). Time from triage to physician evaluation decreased from 63.6 minutes to 25.2 minutes ( $P<.001$ ), and the number of patients waiting decreased from 23.8 to 18.0 ( $P<.001$ ). Analysis of indicators of clinical relevance showed improvements in both absolute risk (reduction of 0.22; 95% CI. 0.19-0.26;  $P<.001$ ) and relative risk (reduction of 0.70; 95% CI. 0.64-0.76). The number of waiting patients fell by 5 (95% CI. 4-6). The ASIGNA program made it possible to attend 4-fold more patients within an amount of time considered reasonable.

**Conclusions:** The use of the ASIGNA program leads to statistically significant and clinically relevant reductions in time from triage to physician evaluation. [Emergencias 2014;26:188-194]

**Keywords:** Patient classification. Wait times. Patient satisfaction. Triage. Hospital emergency health services.

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## Introduction

Waiting time is the main reason for dissatisfaction of emergency department (ED) users<sup>1</sup> and contributes to their leaving before being attended by a ED physician (EPs)<sup>2</sup>. Waiting time may be perceived differently by the clinician, who is not always aware of the anguish generated by prolonged delays in attention<sup>3-7</sup>.

The organizational and operational problems of overcrowded EDs is one of the great challenges for EPs<sup>8-10</sup>. The ED must handle its daily workload with efficiency and quality<sup>8,9</sup>, and attempt to satisfy its users<sup>7</sup>. Increased demand for services does not allow immediate attention of all ED users. Therefore, triage areas for classification and prioritization of

care have been created, to ensure appropriate care of patients according to their needs. This has improved the quality of care provided by the ED<sup>11-14</sup>.

But triage does not ensure that patients are seen by EPs within the stipulated time to be visited, especially prioritized patients who have not been assigned a clinician, and this can contribute to long waiting times<sup>15</sup>.

To reduce time to first EP attention and to achieve greater equity in workloads, we designed a software tool (ASSIGN), adapted to our setting, which allows patient assignment to a physician-nurse team. This is a non-commercial non-patented program, prepared by consensus between ED professionals and the research unit of our department (U.I. Elda in Spanish). The objective of our study

was to determine whether the use of the ASIGNA computer program reduces user waiting time before first EP attention.

## Method

The University Hospital of Elda is a public institution with 513 beds. Currently the ED attends about 57,000 patients annually, representing about 160 adult visitors per day, with specialist attention for all emergencies except obstetrics and gynecology. In 2006 the ED adopted the ALERT® program (based on the Manchester triage system) for the reception, attendance and classification of patients according to symptoms and signs reported by the patient or companion. In this process, the nurse assesses the patient's condition by questioning and taking vital signs. The ALERT® program guides this professional through 52 different reasons for consultation. According to the priority level assigned, the colors red, orange, yellow, green and blue are used. These colors are associated with maximum waiting times, prior to EP attendance: immediate action for red, up to ten minutes for orange, up to 60 minutes for yellow, up to 120 minutes for green and less than 240 minutes for blue.

The ED is divided into three functional areas of weekday work, from 08:00 to 15:00 hours, staffed by flexible teams of doctors and nurses. At level 1 or the general pathology consultation area, there are patients not requiring bed care, orthopedic or pediatric attention. This is staffed by two nurses and three doctors. At level 2, more severe cases who require beds are attended, as well as prisoners and patients with infectious diseases requiring isolation. This is also staffed by two nurses and three doctors. The observation area is for patients seen at any of the two previous levels, pending diagnosis, therapy or hospital admission. This is staffed by two nurses and a doctor. At triage, ED visitors are assigned the most appropriate level of care.

The ASIGNA software using Visual Basic language was introduced in August 2012. It is connected to the Manchester triage system and records the color assigned to both patient and the healthcare teams (number of patients assigned to each team at each level of care). This program is designed to achieve an equitable distribution of patients between different levels of health care professionals, by color or severity level. Since then, the program has been used to organize our ED workload.

To assess the impact of ASIGNA program use

on patient attention, an interventional study was designed. It was non-randomized, with independent data, designed to compare ED visits for the month of February in 2012 (no ASIGNA program) versus February 2013.

We collected data on adults (<18 years) attended at the ED in the month of February in 2012 and 2013, on weekdays and morning shift (with no medical resident presence), after triage classification but before EP assessment. Patients receiving medical care without triage and those who visited the ED at other times were excluded from the study, ED professionals were not informed about this study in order not to influence their way of working and interfere as little as possible with their routine actions. There was no difference in the physical structure, organization and human resources of the ED between the two periods analyzed.

The main outcome variable was the period of waiting time from triage classification to first EP attention (T-EP), measured in minutes quantitatively, and qualitatively according to compliance with times stipulated per color code of the Manchester system, and white (patients coming from another emergency department, Villena, associated to our hospital and treated by doctors with hospital emergency category). As secondary variables we included: sex, age, triage color and occupation, and total number of patients who are in the ED (waiting for care or already attended) at the time of EP attention of a new patient.

For data collection, we used those appearing in the ED discharge report. To calculate times, we used the exact times (day, hour, minute and second) of admission, triage and EP assessment, which were automatically recorded in computerized form. These data were coded and entered into a computerized database. Each record was coded to comply with the requirement regarding patient anonymity. In order to identify possible errors we conducted a review and verification of computer data with subsequent verification of the range, consistency, etc, of the data. The study was approved by the Ethics Committee for Clinical Research of the Hospital de Elda. Informed consent was waived since the study only focused on normal clinical practice in the ED. The study received no external funding.

Quantitative T-EP (in minutes) and qualitative T-EP (correct or incorrect) were analyzed. A pilot test on 100 randomly selected ED patients was performed to estimate the parameters to be compared. With 5% significance the power of the to-

tal sample ( $n = 2,219$ ) for a relative risk (RR) different from 1 was almost 100%.

We also compared the proportions of patients who left the ED without being seen by a doctor and complaints made between the two periods. We used absolute and relative frequencies for qualitative variables and means and standard deviations for quantitative variables. Medians and interquartile ranges were not used since average distributions were assumed to be asymptotically normal. The two periods were compared using chi-square test (Pearson or Fisher, for qualitative variables) and Student t test (for quantitative variables).

Multiple linear regression was used to analyze the relationship of the other variables with T-EP. The basic assumptions (normality, homoscedasticity, collinearity and independence) of the model were tested using graphical and analytical tests. Goodness of fit was measured by ANOVA. The model coefficients were obtained. Binary logistic regression was used to estimate adjusted relative risks (RR) to analyze the relationship between times and the study variables, RRs were adjusted for sex. ASIGNA intervention, color (triage priority), occupation and age. Likelihood ratio was used to measure the goodness of fit of the model. The clinical relevance parameters of the intervention were calculated:

1) absolute risk reduction (ARR) (subtraction of incorrect T-EP times between February 2012 and February 2013); 2) relative risk reduction (RRR) (ratio between RRA and proportion of incorrect T-EP attention with respect to February 2012), and 3) number needed to treat (NNT) in February 2013 to avoid incorrect care times with respect to February 2012.

There was no data loss of the variables analyzed in the study. All analyses were performed with a significance level of 5%. Confidence intervals (CI) of the most relevant parameters were calculated. Data analysis was performed with SPSS 19.0©.

## Results

The proportion of patients who left the ED without being seen by a physician was 1.3% and 0.5%, before and after ASIGNA ( $p < 0.001$ ). The percentage of complaints was 0.1% and 0%, respectively ( $p = 0.2839$ ). Table 1 shows descriptive characteristics of the patients. The mean age was 59.6 (21.1) years and 52.8% were women. With reference to Manchester colors and white, the

most prevalent were yellow (50.4%), followed by green (37.5%). The percentage of T-EP was correct in 78.5% of cases; ED occupation was 21.1 (10.6) patients (33.4% waiting, 95% CI: 32.6 to 34.2%) and T-EP was 45.9 (56.6) minutes. No significant differences in sex or triage color were found. The use of ASIGNA in February 2013 was associated with a significant increase in the percentage of patients seen within the times stipulated, which rose from 68.2% to 90.6% ( $p < 0.001$ ), and a significant decrease in ED occupancy, from 23.8 (11.2) (38.0% waiting, 95% CI: 37.0 to 39.0%) to 18.0 (8.8) patients (27.9% waiting, 95% CI: 26.8 to 29.1%) ( $p < 0.001$ ). We also found a reduction of T-EP, from 63.6 (69.3) minutes to 25.2 (23.0) minutes ( $p < 0.001$ ), It is noteworthy that the average age in 2013 was 61.0 (21.3) years and in 2012 this was 58.0 (20.7) years ( $p < 0.001$ ).

Table 2 shows the quantitative analysis of the main outcome variable T-EP. Multivariate linear regression model was used. The goodness of fit of the model was significant ( $p < 0.001$ ) and the use of ASIGNA was associated with a reduction of 27.3 minutes [95% CI 23.15 to 31.51,  $p < 0.001$ ], after adjusting for sex, age, triage color and ED occupation.

Table 3 shows our analysis of correct T-EP, according to Manchester and white criteria, using a logistic regression model. The model obtained was significant ( $p < 0.001$ ) with a RR of 3.71 [95% CI: 2.77 to 4.96,  $p < 0.001$ ] after adjusting for age, sex, triage color, ED occupation and the ASIGNA program, ED occupation showed a RR of 0.91 [95% CI: 0.90 to 0.92,  $p < 0.001$ ].

Use of the ASIGNA program significantly improved correct attention time, with an absolute RR of 0.22 [95% CI: 0.19 to 0.26,  $p < 0.001$ ], a RRR of 0.70 (95% CI: 0.64 to 0.76) and a NNT of 5 (95% CI: 4-6) (Table 4). In the results by triage color, ASIGNA obtained an absolute RRA that ranged from 0.17 for yellow to 0.29 for green; a RRR of 0.31 for orange to 0.94 for green and NNA ranged from 4 for green to 6 for yellow.

Figure 1 shows predicted probabilities of the multivariate logistic regression model for T-EP, which were significant for ASIGNA (February 2013), with improved outcomes in patients with green and yellow triage colors in relation to the number of patients in the ED.

## Discussion

The present study demonstrates that use of the

**Table 1.** Descriptive and analytical characteristics of the patients visiting the emergency department of "Hospital de Elda" (Spain). Data from February 2012 to February 2013

Variables	Total n = 2.219	February 2012 (no ASIGNA) n = 1.198	February 2013 (with ASIGNA) n = 1.021	p
Age (years) [mean (SD)]	59.6 (21.1)	58.0 (20.7)	61.0 (21.3)	< 0.001
Males [n (%)]	1.048 (47.2)	558 (46.6)	490 (48.0)	0.506
Triage color [n (%)]				0.414
Red	4 (0.2)	2 (0.2)	2 (0.2)	
Orange	228 (10.3)	126 (10.5)	102 (10.0)	
Yellow	1.121 (50.5)	569 (47.5)	552 (54.1)	
Green	832 (37.5)	477 (39.8)	355 (34.8)	
Blue	13 (0.6)	11 (0.9)	2 (0.2)	
White	21 (0.9)	13 (1.1)	8 (0.8)	
Time "triage-1st medical assessment" correct [n (%)]	1.742 (78.5)	817 (68.2)	925 (90.6)	< 0.001
ED occupation (n° of patients) [mean (SD)]	21.1 (10.6)	23.8 (11.2)	18.0 (8.8)	< 0.001
Age (years)	59.6 (21.1)	58.0 (20.7)	61.0 (21.3)	< 0.001
Time "triage-1st medical assessment" (mins)[mean (SD)]	45.9 (56.6)	63.6 (69.3)	25.2 (23.0)	< 0.001

n (%): absolute frequency (relative frequency).

ASIGNA program as a quality management tool is clinically relevant and useful to improve ED functioning, ASIGNA was designed to help reduce the time to first medical care and correct the uneven distribution in the number of patients seen, due to the variability of performance among the professionals. We found that the equitable allocation of patients (all professionals attend the same number of patients according to triage colors within the same care level) actually reduced T-EP as well as the number of patients leaving the ED before being seen by a doctor<sup>16-18</sup>. Due to the study design, we did not assess the impact of ASIGNA in the response capacity of health care teams in improving the times.

Importantly, ASIGNA obtained a significant reduction in time between triage and first medical attention of more than 27 minutes, after adjusting for sex, age, triage color and number of patients in the ED (ED occupation). The program increa-

sed correct attention time 4-fold (RR: 3.71). These results show significant improvement and presumably correlate with greater user satisfaction<sup>1,3,4</sup>.

In the Valencian Community, the health authorities (Conselleria de Sanitat) have established the number of emergency patients seen by the doctor within stipulated times, according to triage classification or color, as a quality indicator of emergency care based on case severity. A standard of 80% compliance with these times was established. Our rate in 2012 was around 70%. The use of ASIGNA has resulted in improvement to above 90%, which ostensibly improves the quality of service provided.

In agreement with Murrell et al.<sup>19</sup>, we believe the good results are due to greater commitment of professionals towards patients assigned to their care, and improved management of their daily work. The Manchester triage system, by itself, does not seem sufficient to improve the efficiency

**Table 2.** Quantitative analysis of time "triage-rated medical" of the patients who come to the emergency department of the Elda Hospital (Spain). Data from February 2012 to February 2013

Variables	Time "triage-1st medical assessment" (mins)	p	GoF (95% CI)	p
Sex [mean (SD)]				0.848
Male	44.8 (53.4)	0.390	0	
Female	46.9 (59.3)		-0.39 (-4.39. 3.60)	
ASIGNA program [mean (SD)]				< 0.001
Yes ( February 2013)	25.2 (23.0)	< 0.001	-27.33 (-31.51. -23.15)	
No (February 2012)	63.6 (69.3)		0	
Triage color [mean (SD)]		< 0.001		< 0.001
Red	8.7 (5.8)		-29.76 (-76.68. 17.17)	
Orange	16.7 (16.9)		-20.61 (-27.46. -13.77)	
Yellow	45.5 (35.9)		0	
Green	66.5 (67.1)		29.92 (25.45. 34.40)	
Blue	142.5 (115.7)		105.33 (79.04. 131.61)	
White	26.8 (37.3)		-9.67 (-30.81. 11.47)	
ED occupation (n° of patients) (r value)	0.335	< 0.001	1.57 (1.373. 1.767)	< 0.001
Age (years) (r value)	-0.094	< 0.001	-0.052 (-0.15. 0.05)	0.308

r: Pearson's correlation; CI: confidence interval; GoF: Goodness of fit of the linear regression model: F = 101.3. p < 0.001.

**Table 3.** Analysis of correct "triage-to-first medical assessment" time according to the Manchester criteria in patients visiting the emergency department, Elda Hospital (Spain). Data from February 2012 to February 2013

Variables	Time "triage-1st medical assessment" (mins)	RR adjusted (95% CI)	p
Sex [mean (SD)]			
Male	805 (77.8)	1.10 (0.86. 1.40)	0.460
Female	916 (79.0)	1 (referencia)	
ASIGNA program [mean (SD)]			
Yes ( February 2013)	917 (90.7)	3.71 (2.77. 4.96)	< 0.001
No (February 2012)	804 (68.0)	1 (referencia)	
Triage color [mean (SD)]			< 0.001
Orange	89 (39.0)	0.09 (0.06. 0.13)	
Yellow	947 (84.5)	1.42 (1.07. 1.87)	
Green	675 (81.1)	1 (referencia)	
Blue	10 (76.9)	0.58 (0.14. 2.41)	
ED occupation (n <sup>o</sup> of patients) [mean (SD)]	19.1 (9.9)	0.91 (0.90. 0.92)	< 0.001
Age (years) [mean (SD)]	58.9 (21.1)	1.00 (0.99. 1.01)	0.889

RR: relative risk; CI: confidence interval; Pearson's correlation; CI: confidence interval. GoF: Goodness of fit of the linear regression model: chi squared = 622.8, p < 0.001. Triage colors red and white excluded due to low sample size..

and quality of the ED20, ASIGNA complements the system of triage, which improves care times without new resources or increasing costs, as in other interventions<sup>12,21-23</sup>.

Although there are interventions in the emergency department using computer systems to assign patients to EPs, the results are difficult to compare because of different designs, locations, models and health areas<sup>18,19</sup>. These studies showed a positive effect in reducing waiting times, as in our work. The best results were achieved with patients classified as green and yellow, in relation to the number of patients in the ED. However, the sample size of patients classified with other colors was insufficient to be able to draw any reliable conclusions.

Among the limitations of the study is the problem of external validity of our results, because they are only applicable in certain conditions: specific emergency personnel, adult care, morning shift and weekdays. We do not know whether these results can be extrapolated to other EDs or even to our own real situation with all the shifts, holidays included, pediatric care, and different

professionals including medical residents and duty doctors. We chose the morning shift with maximum attendance of ED patients<sup>1</sup> and the month of February as the minimum period (6 months) that would allow us to evaluate the results of the intervention<sup>24</sup>. Moreover, although the patients with the same triage color could have different triage care burdens, we believe that the distribution of patients by levels means these workloads can be considered comparable. We also accept, for ethical reasons, the limitation of this not being a randomized clinical trial. Similarly, we accept a certain selection bias due to differences in average age between the two groups and a measurement bias due to lack of blinding. However we think that the unfavorable age bias makes our results more relevant.

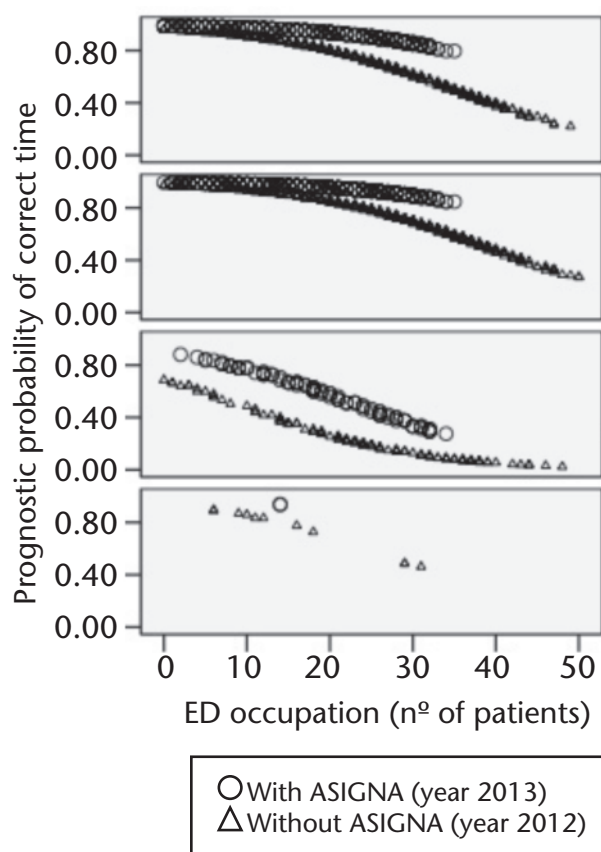
We propose to perform a future multicenter study under usual ED conditions with a longer period of observation, without restrictions, with increased sample size to improve statistical power and enable conclusions to be drawn for all Manchester triage colors and white. Furthermore, in this study it would be interesting to know the de-

**Table 4.** Analysis of clinical relevance of the computerized system for correct "triage-to-first medical assessment" time according to the Manchester criteria in patients visiting the emergency department, Elda Hospital (Spain). Data from February 2012 to February 2013

Color	ASIGNA correct time n (%)	Correct time n (%) without ASIGNA	RRR (95% CI)	RRA (95% CI)	NNA (95% CI)	P
All	925 (90.6)	817 (68.2)	0.70 (0.64. 0.76)	0.22 (0.19. 0.26)	5 (4. 6)	< 0.001
Orange	52 (51.0)	37 (29.4)	0.31 (0.13. 0.45)	0.22 (0.09. 0.34)	5 (3. 12)	< 0.001
Yellow	515 (93.3)	432 (75.9)	0.72 (0.61. 0.80)	0.17 (0.13. 0.21)	6 (5. 8)	< 0.001
Green	348 (98.0)	327 (68.6)	0.94 (0.87. 0.97)	0.29 (0.25. 0.34)	4 (3. 4)	< 0.001

RR: relative risk; CI: confidence interval; Pearson's correlation; CI: confidence interval. GoF: Goodness of fit of the linear regression model: chi squared = 622.8, p < 0.001. Triage colors red and white excluded due to low sample size..





**Figure 1.** Prognostic probability of the multivariate model for correct triage-to-first medical assessment time according to priority color of the Manchester triage system

gree of satisfaction<sup>3-6</sup>, for both users and professionals, as a result of implementing ASIGNA, and whether any benefit persists over time.

In conclusion, we believe that the use of the ASSIGN program to complement the triage system reduces the time to first medical care, and contributes to better organization and operation of the ED, at least for weekday morning shifts (with fixed ED staffing) and adult patients.

## Addendum

Composition of the Research Group of the Elda University General Hospital Virgen de la Salud: M<sup>a</sup> Ángeles Carbonell Torregrosa\*, Amós Urbía Palacios, Antonio Palazón Blu, Vicente Carrasco Tortosa, Vicente Gil Guillén\*, Pablo Martínez Cánovas, José María Román Romero, Concepción Beneyto Ripoll, Patricia López Espinós, Ana Martínez Díaz, Natalia Aurora Pérez Ramírez, Miguel Navarro Juan, José Sigüenza Ortiz, M<sup>a</sup> Carmen Beltrá Soria, Alejandro Adsuar Parreño, Avelino Pereira Expósito, Elisabeth Berzosa Sola. \* Group Coordinators.

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## Impacto de la implantación del programa asigna en un servicio de urgencias hospitalario

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**Objetivos:** Determinar si el programa informático ASIGNA, basado en la asignación de pacientes por equipo enfermero-médico, reduce el tiempo de espera de los usuarios antes de ser valorados por *urgenciólogos* del Hospital de General Universitario de Elda.

**Método:** Estudio de intervención no aleatorio, realizado en febrero de 2012 y febrero de 2013, tras la instauración del programa ASIGNA. Se determina como variable principal, el tiempo entre el *triaje* y la valoración por el *urgenciólogo*, cuantitativamente en minutos y de forma cualitativa mediante el cumplimiento o no de los tiempos determinados para cada color del *triaje* Manchester. Las variables secundarias fueron: sexo, edad, color de *triaje* y la cola o densidad de pacientes. Se utiliza el análisis multivariante de regresión lineal múltiple (tiempo *triaje*-valoración médica en minutos) y regresión logística (tiempo correcto). Se calculan los indicadores de relevancia clínica.

**Resultados:** ASIGNA aumenta el porcentaje de *triaje* realizado correctamente del 68,2 al 90,6% ( $p < 0.001$ ), reduce el tiempo *triaje*-valoración médica de 63,6 min a 25,2 min ( $p < 0,001$ ) y reduce la cola de pacientes de 23,8 a 18,0 ( $p < 0,001$ ). Los indicadores de relevancia clínica fueron: reducción del riesgo absoluto de 0,22 (IC 95%: 0,19-0,26,  $p < 0,001$ ); reducción del riesgo relativo de 0,70 (IC 95%: 0,64-0,76) y números de pacientes a asistir de 5 (IC 95%: 4-6). ASIGNA multiplica por 4 la posibilidad de atender a un paciente que acuda a urgencias en tiempo correcto.

**Conclusión:** La aplicación del programa ASIGNA obtiene una reducción estadísticamente significativa y clínicamente relevante del tiempo entre *triaje* y valoración médica [Emergencias 2014;26:188-194]

**Palabras clave:** Asignación de pacientes. Tiempos de espera. Satisfacción del paciente. *Triage*. Servicio de urgencias hospitalario.