Project S32: decision support system for lung cancer patients

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Purpose and Objective

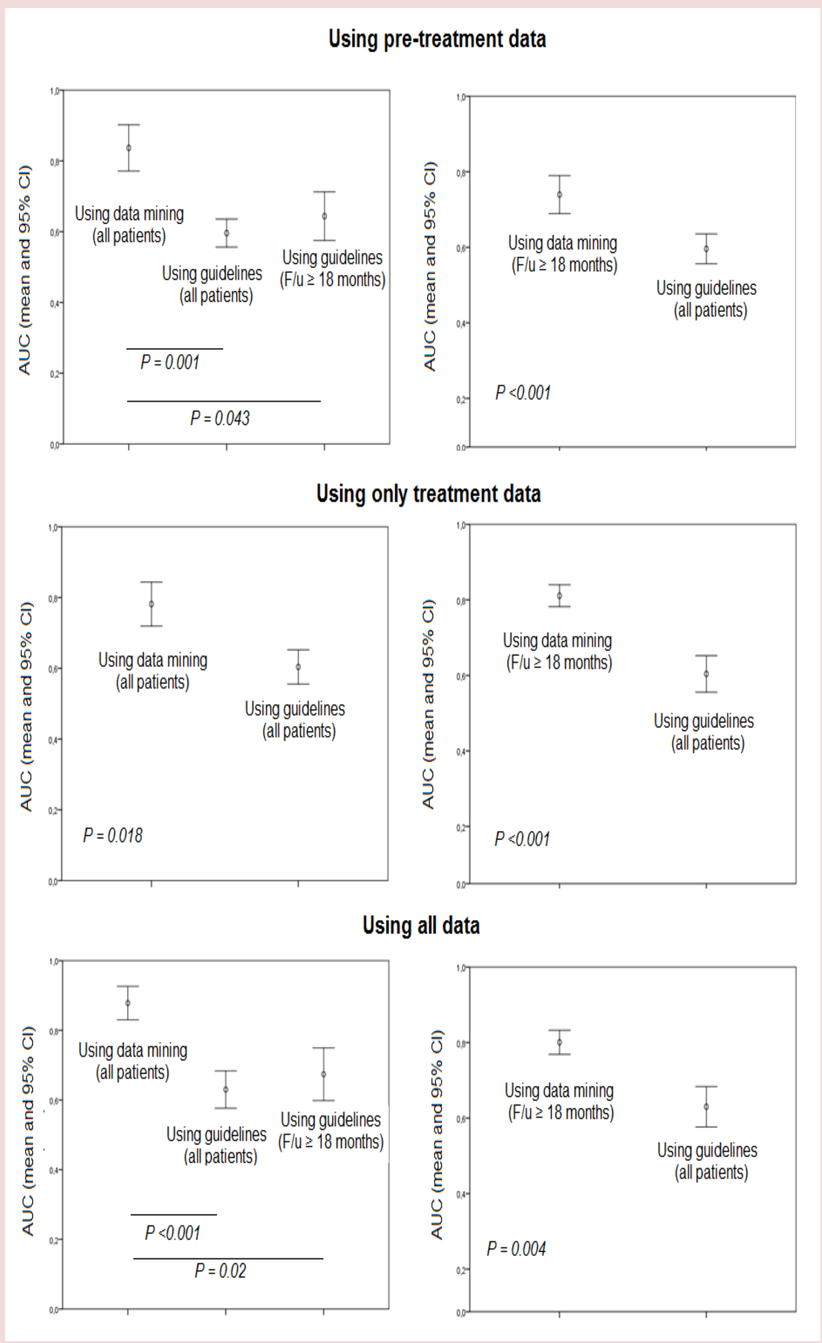
- A decision support system (DSS) has been proposed to predict survival and apply knowledge from routine care data rather than solely relying on clinical guidelines in lung cancer (LC) patients.

Material and methods

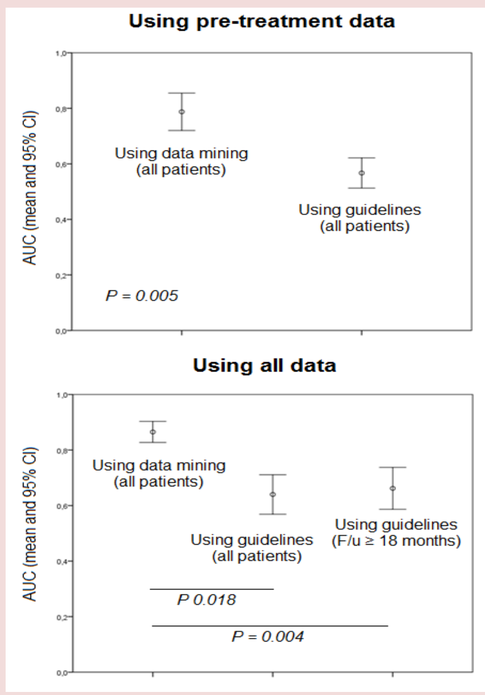
- To implement the technological architecture of this DSS, we integrated a set of open source tools which allowed us to register information during daily clinical practice through electronic health records and use this information to automatically execute different Data Mining analyses.
- It is based on the XGBoost and Generalized Linear Models algorithms applying a 10-fold cross validation to explore its potential for predicting survival from a heterogeneous dataset.
- Prospective multicenter data from 543 consecutive LC patients that were seen in consultation in the radiation oncology departments from January 2013 to July 2017 were available to enable the development of the prediction model.
- There were 229 (42%) alive patients and 314 deaths at the time of the study. The data set had more than 400 items but only a proportion of them (including, among others, age, gender, histology, performance status, stage, and treatment approach) with discriminatory ability according the algorithms were used.
- Different time´s periods (pre-treatment, treatment) were assessed for prediction. Additionally, a subset of patients with a minimum follow-up of 18 months for alive patients was also assessed.
- Area under the receiver-operating characteristics curve (AUC) measured performance. The results were compared with the AUC obtained using the basic items included in the guidelines (pretreatment data [stage, histology] and treatment data [radiotherapy, surgery, and systemic therapy]).
- The comparison of the different AUCs obtained from 10 simulations for each rule was done using the one-way analysis of variance (ANOVA), obtaining their confidence intervals at 95%. Multiple comparisons, when the hypothesis of homoscedasticity was not verified, were performed by the Games-Howell correction.

Results

Comparison of the AUCs and 95% CI for predicting survival in all lung cancer patients when using data mining analyses vs the guidelines.



Comparison of the AUCs and 95% CI for predicting survival in non-small cell lung cancer patients when using data mining analyses vs the guidelines.



Comparison of the AUCs and 95% CI for predicting survival in small cell lung cancer patients when using data mining analyses vs the guidelines.

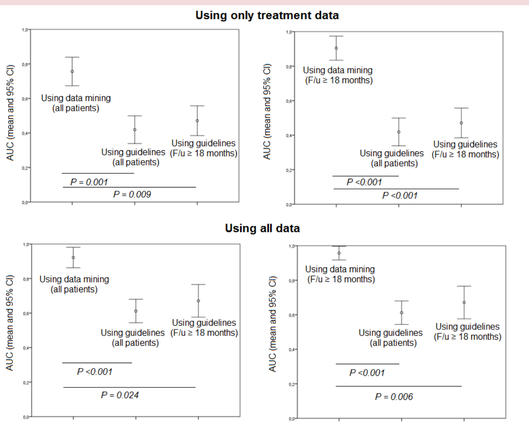


Table. AUC(mean and 95% CI)for predicting survival using either data mining analyses or basic items included in the guidelines in lung cancer patients.

Data	Predictive model for mortality							
	Using data mining				Using guidelines			
	Lung cancer patients							
	All patients (N=543)		Patients with a minimum follow-up of 18 months for alive patients (N=451)		All patients (N=543)		Patients with a minimum follow-up of 18 months for alive patients (N=451)	
	N*	**AUC**	**N***	**AUC**	**N***	**AUC**	**N***	**AUC**
Using pre-treatment data	20	0.84 (0.77-0.90)	6	0.74 (0.69-0.79)	2	0.60 (0.56-0.64)	2	0.64 (0.58-0.71)
Using only treatment data	9	0.78 (0.72-0.84)	10	0.81 (0.78-0.84)	3	0.60 (0.56-0.65)	3	0.65 (0.58-0.72)
Using all data	35	0.88 (0.83-0.92)	34	0.80 (0.77-0.83)	5	0.63 (0.58-0.68)	5	0.67 (0.60-0.75)
	Non-small cell lung cancer							
	(N=405)		(N=343)		(N=405)		(N=343)	
Using pre-treatment data	20	0.79 (0.72-0.85)	20	0.70 (0.64-0.76)	2	0.57 (0.51-0.62)	2	0.58 (0.50-0.67)
Using only treatment data	24	0.77 (0.72-0.82)	25	0.78 (0.73-0.84)	3	0.63 (0.56-0.70)	3	0.66 (0.57-0.75)
Using all data	17	0.81 (0.80-0.83)	32	0.77 (0.71-0.85)	5	0.64 (0.60-0.71)	5	0.66 (0.59-0.74)
	Small cell lung cancer							
	(N=138)		(N=108)		(N=138)		(N=108)	
Using pre-treatment data	19	0.82 (0.74-0.91)	20	0.73 (0.59-0.87)	2	0.67 (0.52-0.81)	2	0.74 (0.61-0.87)
Using only treatment data	22	0.76 (0.67-0.84)	23	0.90 (0.83-0.97)	3	0.42 (0.34-0.50)	3	0.47 (0.38-0.56)
Using all data	33	0.92 (0.86-0.98)	34	0.96 (0.92-0.99)	5	0.61 (0.54-0.68)	5	0.67 (0.58-0.77)

*Number of variables with discriminatory ability according the algorithms

*Number of variables according guidelines

Conclusions

- Our DSS successfully handled a high number of heterogeneous variables, demonstrating potential for enhancing prediction of survival.
- The DSS could assist physicians in formulating an evidence-based management advice in patients with LC.
- This DSS might be used in a clinic as an objective guide to individualize treatment, and discussions with patients, according to prognosis.

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