APPROPRIATEZZA DEGLI ESAMI DI LABORATORIO
I RISVOLTI ECONOMICI

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UNIVERSITÀ DEGLI STUDI DI FERRARA
- EX LABORE FRUCTUS -

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Key concepts

- The appropriate laboratory utilization could be achieved when clinicians order the right tests, at the right time, in the right order;
- The early repeat test is one that followed a preceding test of the same type before the test specific time interval had elapsed;
- The redundant test is an early repeat test that might be eliminated with little loss of information.

Estimates for the proportion of inappropriate tests

- Many studies and reports indicated that a significant proportion (25%-40%) of laboratory testing performed is inappropriate;
- A systematic review cited large variations in the estimates of inappropriate laboratory use (4,5%-95%)

Strategies to improve laboratory test - ordering

- Clinical practice guideline and Clinical algorihms;
- Education;
- Feedback;
- Computer-based systems;
- Administrative strategies

Impact of CPOE + computerized decision support systems on pathology

REFERENCE	MEASURE/INDICATORS	RESULTS
KUPERMAN, GILAD J., ET AL. (1999)	**Time to treatment**	Intervention group had a 38% shorter median time interval than the control group
THOMPSON W., DODEK P. M., NORENA M., DODEK J. (2004).	**TAT**	Decreased from 148 to 74 min (p<0,001)
BATES D.W., KUPERMAN G.J., RITTENBERG E., TEICH J.M., FISKIO J., MA'LUF N. (1999),	**Satisfaction of physician**	Satisfaction is lower (3,5 on 1 to 7 scale) (Bates, Kuperman, 1999)
BATES D.W., KUPERMAN G.J., RITTENBERG E., TEICH J.M., FISKIO J., MA'LUF N. (1999),	**Order appropriateness**	27% of redundant test are performed
PROCOP G,., YERIAN, L.M (2014)	**Volume of tests (number of tests ordered per day)**	56,21% unnecessary duplicated orders blocked
Bates, David W., et al.(1997)	**Test's costs**	No significant difference
TIERNEY W.M, MCDONALD C.J., MARTIN D.K., ROGERS M.P. (1987),	**Length of stay (mean)**	The mean length of stay was 0,89 of a day shorter

Objective

- Primary objective of the present study is to determine whether the management intervention, consisting of guideline development, computerized order template design, and educational efforts, could decrease test utilization without affecting clinical outcomes.

To that end a study has been conducted at Ferrara health authority (Asl) and Ferrara Teaching Hospital

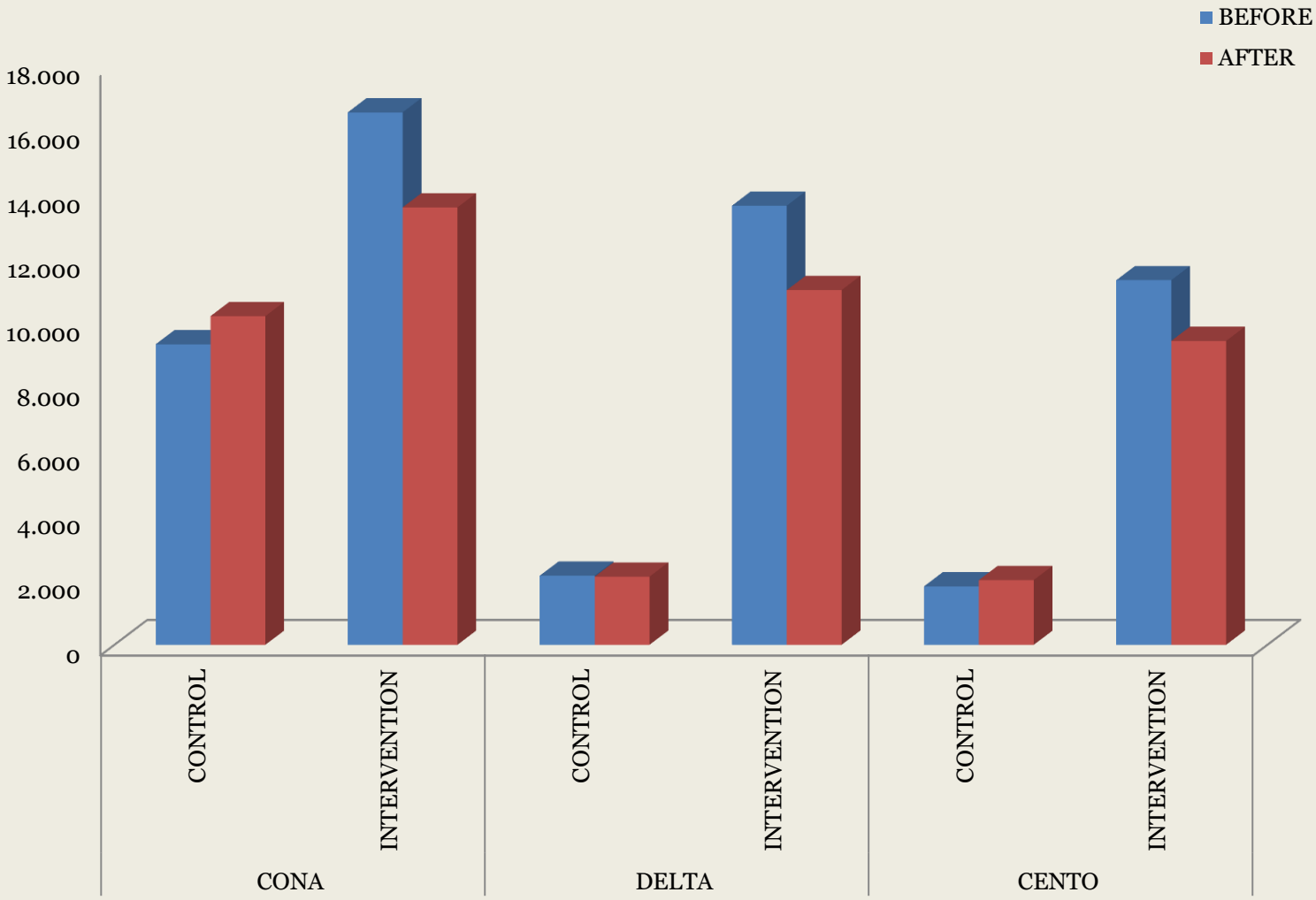
Analysis

- The primary measure is the number of test ordered in different wards;
- A secondary measure is the aggregate utilization, which is estimated by multiplying the number of each test for which the procedure was active, by its unit cost;
- The test utilization during an intervention period (April through June 2015) has been compared to the utilization in the same ward prior to intervention;
- We choose the same months in the preceding years (2013 and 2014) to minimize the effect of seasonal variation.

Total number of tests

Organization	INTERVENTION	TEST ORDERS BEFORE	TEST ORDERS AFTER	Δ %	CONTROL	TEST ORDERS BEFORE	TEST ORDERS AFTER	Δ %
TH at CONA	*UO: INTERNAL MEDICINE*	**16.538**	**13.586**	**-17,8**	*UO: MEDICAL CLINIC*	**9.334**	**10.209**	**9,37**
H DELTA	*UO: CARDIOLOGY*	2.862	2.791	-2,48	*LPA*	2.146	2.115	-1,44
	UO: MEDICINE	13.637	11.016	-19,22	*UTIC*	1.473	1.445	-1,90
	TOTAL	**16.499**	**13.807**	**-16,32**	**TOTAL**	**3.619**	**3.560**	**-1,63**
H CENTO	*UO: CARDIOLOGY*	2.145	2029	-5,41	*LPA*	1.813	2.010	10,87
	UO: MEDICINE	11.324	9438	-16,65	*UTIC*	1.516	1.114	-26,52
	TOTAL	**13.469**	**11.467**	**-14,86**	**TOTAL**	**3.329**	**3.124**	**-6,16**

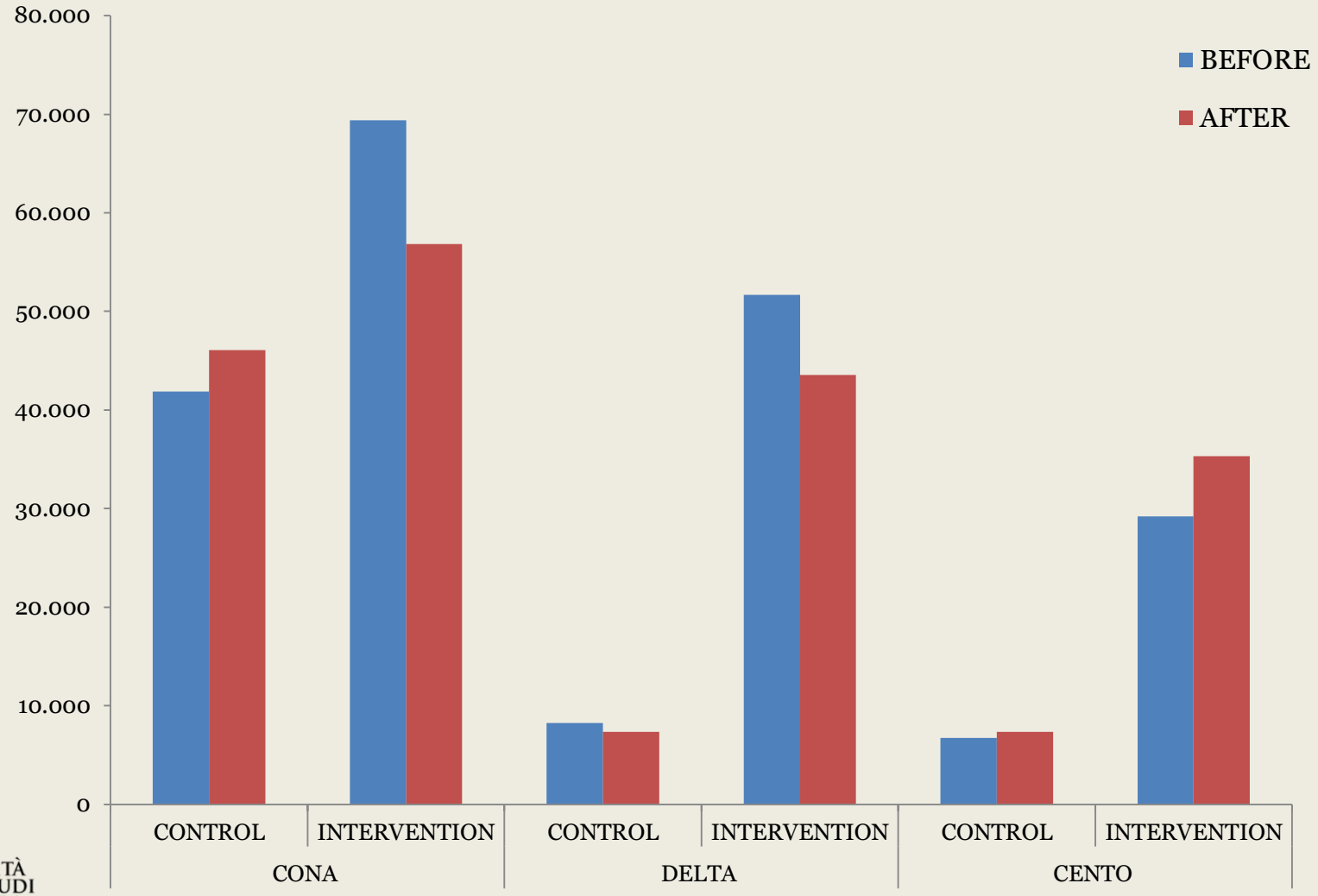
Tests performed



Test costs

	INTERVENTION	COST TEST BEFORE	COST TEST AFTER	Δ %	CONTROL	COST TEST BEFORE	COST TEST AFTER	Δ %
TH at CONA	*UO: INTERNAL MEDICINE*	**69.407**	**56.833**	**-18,11**	*UO: MEDICAL CLINIC*	***41.856***	*46.054*	**10,02**
H DELTA	*UO: CARDIOLOGY*	10.951,90	10.433,50	-4,73	*LPA*	8.233,20	7.333,80	-10,92
	UO: MEDICINE	51.706,50	43.566,55	-15,74	*UTIC*	6.769,80	6.314,70	-6,72
	TOTAL	**62.658**	**54.000**	**-13,82**	**TOTAL**	**15.003**	**13.648,50**	**-9,03**
H CENTO	*UO: CARDIOLOGY*	8.170,45	7.546,85	-7,63	*LPA*	6.717,55	7.341,15	9,28
	UO: MEDICINE	43.889	35.313,4	-19,54	*UTIC*	6.539,7	4.329,2	-33,80
	TOTAL	**52.059,45**	**42.860,25**	**-17,67**	**TOTAL**	**13.257,25**	**11.670,35**	**-11,97**

TEST COSTS


80.000
70.000
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BEFORE
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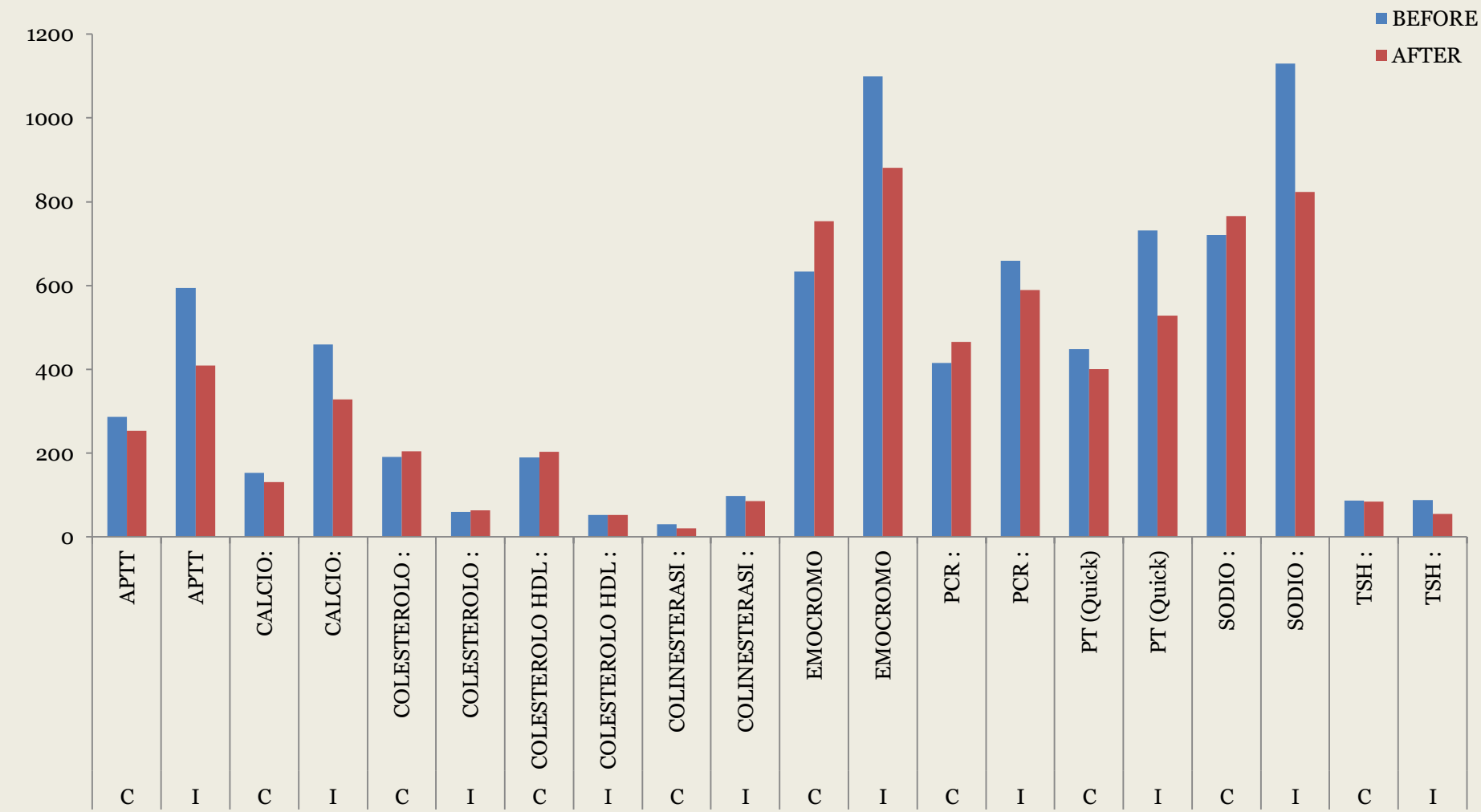
Demographic and clinical characteristics of patients

TH CONA			H DELTA			H CENTO		
INTERNAL MEDICINE	**BEFORE**	**AFTER**	**MEDICINE**	**BEFORE**	**AFTER**	**MEDICINE**	**BEFORE**	**AFTER**
ADMISSIONS(n)	274	255	ADMISSIONS(n)	436	514	ADMISSIONS(n)	355	344
FEMALE (%)	55,83	60,0	FEMALE (%)	49,34	52,73	FEMALE (%)	50,7	53,8
MEAN AGE	75,25	75,46	MEAN AGE	53,21	55,64	MEAN AGE	54,1	57,3
IN-HOSPITAL MORTALITY (rate per 100 admission)	10,21	13,3	IN-HOSPITAL MORTALITY (rate per 100 admission)	12,16	14,79	IN-HOSPITAL MORTALITY (rate per 100 admission)	13,2	15,4
30-DAY READMISSION RATE (per 100 admissions)	2,18	2,74	30-DAY READMISSION RATE (per 100 admissions)	13,99	14,79	30-DAY READMISSION RATE (per 100 admissions)	8,73	11,34

Test performed when reminder was triggered

TEST	MEDICINE at TH in CONA April- June 2015			
	2014		2015	
	N	COST	N	COST
ACIDO FOLICO:	110	1.100	49	490
ACIDO URICO :	340	680	301	602
APTT	594	1.782	409	1.227
B 12 :	109	1.090	48	480
CA 15.3 :	18	342	8	152
CA 19.9 :	40	680	22	374
DIGOXINA :	20	244	12	146
CA125 :	18	342	7	133
CALCIO:	459	918	328	656
CEA :	44	484	25	275
COLESTEROLO :	60	120	64	128
COLESTEROLO HDL :	53	106	53	106
COLINESTERASI :	98	196	86	172
EMOCROMO	1.099	4.396	881	3.524
FERRITINA :	101	1.010	52	520
FT4 :	53	530	43	430
GLUCOSIO :	366	732	320	640
Hb GLICOSILATA (HbA1c)	30	330	18	198
IgA :	10	60	5	30
LDH :	377	754	345	690
PCR :	659	3.295	589	2.945
PROTEINE :	58	116	35	70
PSA :	19	209	13	143
PT (Quick)	732	2.196	528	1.584
SODIO :	1.130	2.260	823	1.646
TRIGLICERIDI :	62	124	64	128
TROPONINA T :	313	5.321	241	4.097
TSH :	88	704	55	440
TOTALE	7060	30121	5424	22026

Test performed



Reminders accepted and test performed at UO of MEDICINE - CONA TH April - June 2015

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TEST	TEST potentially inappropriate (%)	TEST repeated (%)	TEST NON repeated (%)
ACIDO FOLICO:	10,20	4,08	6,12
ACIDO URICO :	15,61	6,31	9,30
APTT	11,98	6,36	5,62
B 12 :	10,42	4,17	6,25
CA 15.3 :	12,50	12,50	
CA 19.9 :	4,55	0,00	4,55
DIGOXINA :	16,67	8,33	8,33
CA125 :	14,29	0,00	14,29
CALCIO:	3,66	2,13	1,52
CEA :	8,00	4,00	4,00
COLESTEROLO :	23,44	9,38	14,06
COLESTEROLO HDL :	7,55	5,66	1,89
COLINESTERASI :	4,65	3,49	1,16
EMOCROMO	12,71	8,06	4,65
FERRITINA :	7,69	5,77	1,92
FT4 :	2,33	0,00	2,33

Reminders accepted and test performed at UO of MEDICINE - CONA TH April - June 2015

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TEST	TEST potentially inappropriate (%)	TEST NON repeated (%)	TEST NON repeated (%)
GLUCOSIO :	1,88	0,94	0,94
Hb GLICOSILATA (HbA1c)	11,11	5,56	5,56
IgA :	20,00	0,00	20,00
LDH :	3,19	2,03	1,16
PCR :	3,57	2,55	1,02
PROTEINE :	77,14	37,14	40,00
PSA :	7,69	7,69	-
PT (Quick)	5,30	3,03	2,27
SODIO :	1,22	0,49	0,73
TRIGLICERIDI :	17,19	9,38	7,81
TROPONINA T :	0,41	0,00	0,41
TSH :	7,27	5,45	1,82

Reminders accepted and tests performed April -June 2015 (Internal Medicine -Cona)

TOTAL ALARMS = 388
FORCED = 214 (55,14%)
NOT REPEATED = 174 (44,84%)

Discussion

- We demonstrated a reduction in testing after an intervention consisting in giving physicians computerized reminders related to apparently redundant clinical laboratory tests.
- This result is more relevant when data related to a control unit is considered.
- The measured results were not associated with any change in clinical outcomes, although our power to detect such a change is limited to the aggregate data.

Next steps of the research

To analyze the extent to which reminders for apparently redundant laboratory tests affects:

- The number of tests ordered;
- The number of test performed;
- The proportion of overrides of reminders justified;
- The cancellation of tests resulted in adverse effects for patients;
- The charge savings;

Patients and outcomes

Specific Setting: Sant'Anna Hospital (Cona)

Study Objectives: To determine the cost-effectiveness of SIP to reduce utilization of redundant laboratory tests

Patient baseline demographics **:** All inpatients during the 4-month period between April and June 2014-2015 ;

Outcome measures

Outcome 1: Proportion of reminders accepted

Outcome 2: Proportion of test performed after reminder

Outcome 3: Proportion of tests performed earlier than test-specific intervals

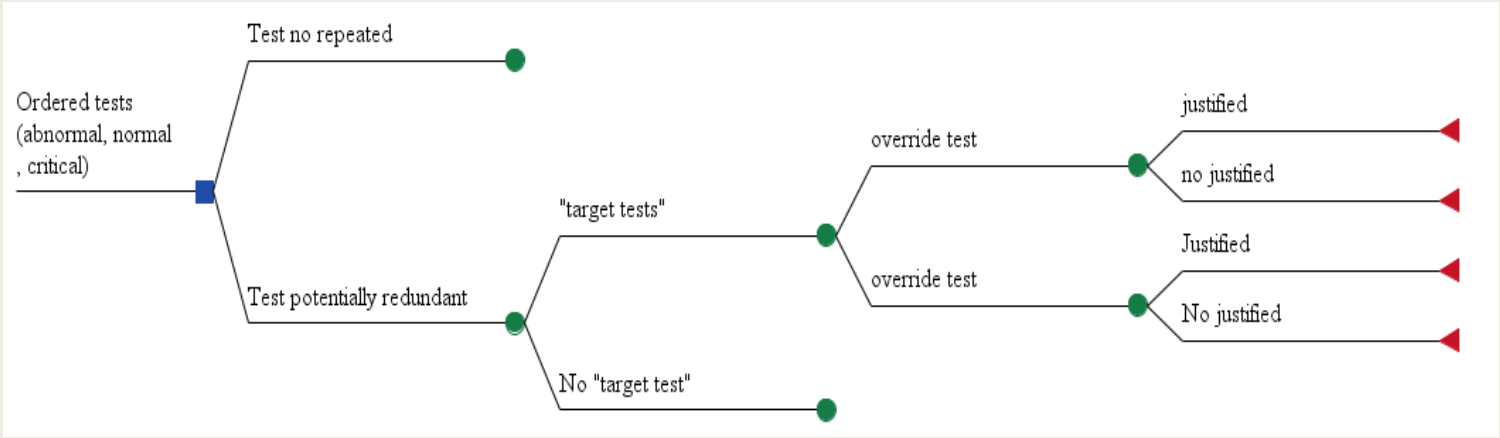
Outcome 4: Proportion of justified overrides of reminders by specific test

Outcome 5: Adverse effects of test cancellation (new abnormal results for the same test performed within 3 days of cancellation)

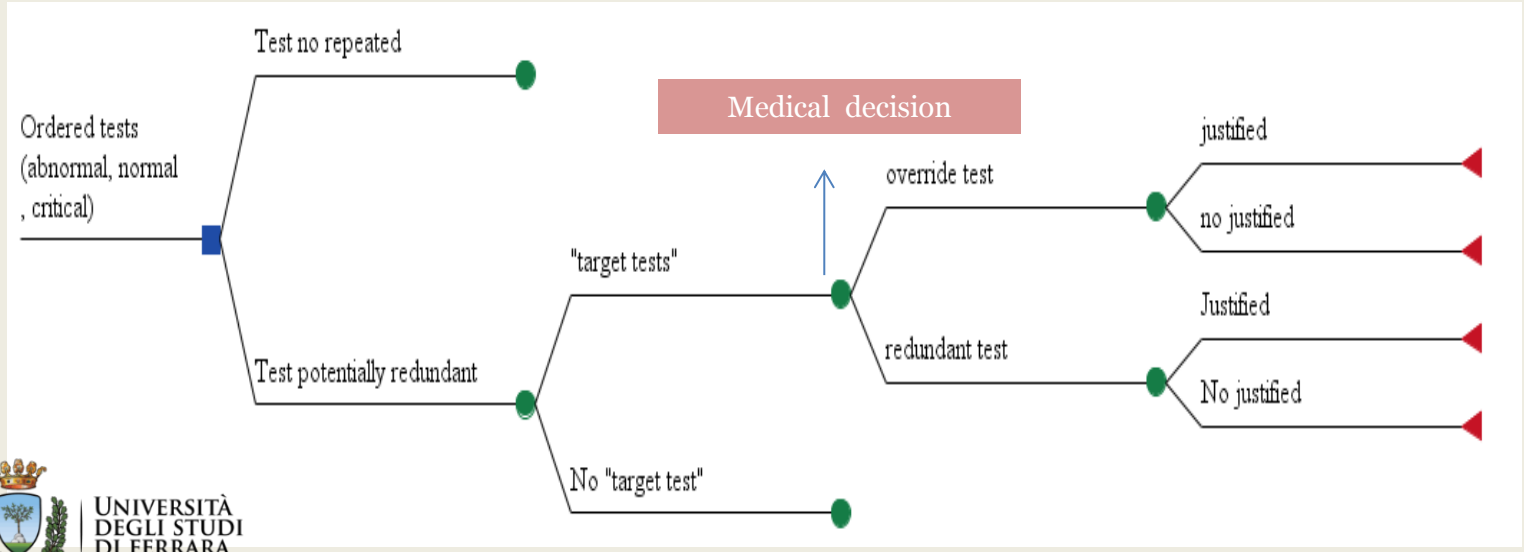
Outcome 6: Charge savings associated with reminders for redundant tests

Methods of statistical analysis: Comparisons between intervention and control group and between different time periods made using *multiple regression models*. *Annual charge* savings estimated by multiplying the charges for each test by the number of test cancelled, and annualized to 1 year.

Characteristics of the appropriate model to evaluate the cost-effectiveness



BEFORE SIP



AFTER SIP

Cost – effectiveness parameters

I	Costs associated with implementation of CPOE (licensing, integration software and interfaces, training and user support..)
CM_b	Mean cost of tests performed **before** .
N_0	Number test performed **before**
CM_a	Mean cost of tests performed **after**
N_1	Number test performed **after**
E_0	Number of overriders of reminders justified **before**
E_1	Number of overriders of reminders justified **after**

$$\Delta C = \Delta I - (N_0 - N_1)\, \Delta C\, M$$
$$\Delta E = E_1 - E_0$$
$$ICER = \Delta C / \Delta E$$

Conclusion

- It is important to associate each test to the patient characteristics to model the cost-effectiveness on covariates;
- To evaluate the effectiveness of reminders it must be demonstrated that cancellation of redundant tests appeared to result in little or no loss of clinical information;
- To evaluate the potential consequences to eliminating test that appeared **redundant** it is necessary to evaluate the proportion of early repeats and the frequency with which repeated tests had a result that represent a change from the first result.

Thank you for the attention!

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