

# The colorectal cancer screening program in the Local Health Unit n. 6 of Livorno: evaluation of the screening activity in the period 2000-2011

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## Key words

Faecal occult blood test • Colorectal cancer screening program • Evaluation

## Summary

**Introduction.** The colorectal cancer screening program in the Local Health Unit n. 6 of Livorno is running since July 2000 and is meant to residents, aged between 50 and 70, who are invited to perform the test for faecal occult blood every 2 years. The aim of this work is an evaluation of the screening activity in the period 2000-2011.

**Methods.** The evaluation is based on the analysis of the main quality indicators formulated by GISCoR (Italian Group for Colorectal screening).

**Results.** The screening activity extension reached 93% in 2006 and 100% in 2009. The compliance level was maintained above the acceptable GISCoR value (> 45%) with a maximum of 54.9%. Values around 80% were recorded for the compliance to colonos-

copy. The detection rate (DR) for cancer and advanced adenoma showed, as expected, the highest values in the early years and then move on values consistently lower than the regional average. In 2011, the raw DR for cancer was 0.9 x 1000 and the raw DR for advanced adenoma 5.3 x 1000.

The distribution by stage at diagnosis of screen-detected carcinomas shows that 58.1% of these were identified at stage I while the proportion of cases in stage III+ is 19.5%.

**Conclusions.** The overall analysis shows a good performance of the program. The proportion of colonoscopies performed on the total number of positive subjects remains a critical point of the system. The distribution by stage of screen-detected cancers shows an excellent diagnostic anticipation of the screening program.

## Introduction

Colorectal cancer (CRC) is the most common newly-diagnosed cancer and the second most common cause of cancer deaths in Europe [1]. Screening for colorectal cancer using the faecal occult blood test has proven effective in reducing mortality from colorectal cancer [2]. Randomized trials in people of average risk invited to attend screening have shown a reduction in cause-specific mortality [3-6] and incidence [6, 7].

The Tuscany Region (TR) with the Deliberations n. 18, dated Feb. 3<sup>rd</sup>, 1998, and n. 24, dated Jan. 11<sup>th</sup>, 1999, has issued "Guidelines for Local Health Authorities in relation to cancer screening programs for cervical, breast, colorectal cancer and melanoma". According to those regional acts, the local health authorities all over the Region were required to activate cancer screening programs or to implement existing ones.

By the Decree of the President of the Council of Ministers, dated Nov. 29<sup>th</sup>, 2001, the screening of colorectal cancer has been defined an Essential Level of Care. In Local Health Unit (LHU) Livorno colorectal cancer screening has been running since July 2000.

The objective of this work is an evaluation of the screening activity in the period 2000-2011, through the analysis of the main indicators of quality set by the Italian Group for the Colo-Rectal Cancer Screening (GISCoR) [8] and

subject to monitoring by the Regional Reference Centre (RRC- ISPO).

## Methods

The program is aimed at people aged 50-70 years living (registered residence) in the territory of the Local Health Unit of Livorno who are invited to perform the faecal occult blood test (FOBT) every 2 years. The annual average target population of the period considered was 48 011 (min. 46 889, max. 48 980). The organizational model includes the recruitment by invitation letter signed by the Coordinator of Medical Screening Centre and the General Practitioner. The letter indicates the location (Social Health Centre) and the time of the delivery of the faecal occult blood test kit; at the same time are indicated the modes of redelivery. The test kits returned are sent to laboratory analysis, which employs the method of processing by latex agglutination for automatic reading and evaluation of the positivity with a cut-off of 100 ng/ml. Subjects with negative results are advised by mail accompanied by a letter of the Screening Centre which informed them that they will be invited to repeat the test in 2 years. Subject with positive results are contacted by telephone by health care workers of the Screening Centre, invited to a counselling by the Centre

and initiated to the subsequent diagnostic and therapeutic steps.

The program, like all cancer screening programs in the Tuscany Region, is the subject of continuous monitoring and epidemiological evaluation by the Regional Reference Centre through the annual production of indicators which become the basis for the drafting of an Annual Report that summarizes the activity and the quality of all the regional screening programs. In this paper the analysis considered the following indicators: *extension of invitations*: refers to the ratio between the number of subjects invited and the total number of eligible subjects in the period [8]; *compliance to invitation*: refers to the ratio between the number of subjects respondent and the total number of subjects invited [8]; *FOBT positivity rates*: represents the percentage of people with a positive test result on the total number of people tested [8]; *compliance to colonoscopy*: represents the percentage of people who have conducted the colonoscopy on the total number of people invited to conduct the examination [8]; *completeness rate of colonoscopies*: it is an indicator of the examination quality and represents the proportion of complete colonoscopies performed (caecal intubation) [8]; *detection rate for cancer and advanced adenoma*: this indicator expresses the ratio between the number of subjects diagnosed with cancer or advanced adenoma identified at screening and the number of subjects screened [8]; *positive predictive value (PPV) for cancer and advanced adenoma*: expresses the ratio between the number of subjects with histologically confirmed diagnosis of cancer or advanced adenoma or simple adenoma and the total number of subjects who performed colonoscopy after positive faecal occult blood testing [8]; *the stage at diagnosis* of screen-detected carcinomas.

## Results

In 12 years of activity of the program there was a progressive increase of the extension with the attainment of

the desirable standard as early as 2002 (GISCoR Standard: acceptable > 80%; desirable > 90%). Beyond the fluctuations due to changes in the allocation of resources, the level of extension is always maintained at high values and from 2009 has stabilized at more than 100%. The overall compliance, adjusted to subjects excluded after invitation and invitations without result, except for the first two years of program activation remains still above the rate considered acceptable in the GISCoR manual [8] (Standard GISCoR: acceptable > 45%; desirable > 65%). The general trend shows an increase over the period and with values ranging from 38% in 2000 to 49.5% in 2011 with a maximum of 54.9% in 2007. In the early activation of the screening program, the percentage of positive test is found to be higher than the regional average due to the use of a test with a lower specificity (Tab. I). The transition to a test of specificity in line with other tests used in the region, has led to positive values within the standards set forth by GISCoR [8]. Disaggregated data for the first and repeated screening was available from 2003 onwards.

From 2004 onwards, the positivity rate at repeated screening is, as expected, lower than those of the first screening (screening of prevalence), with some exception attributable to random fluctuations (Standard GISCoR: *first screening* acceptable < 6%; desirable < 5%, *repeated screening* acceptable < 4.5%; desirable < 3.5%).

About the compliance to the colonoscopy (GISCoR standards are > 85% acceptable and > 90% desirable) the graph (Fig. 1) shows that there was an initial gap in Livorno program compared to the regional average. From 2003 onwards, the rates align perfectly with the regional average. However, they remain below the acceptable standard pointing out a permanent feature related to the fact that about 20% of those with a positive test does not perform colonoscopy exam or, at least, the program does not become aware of it. Linking compliance to colonoscopy with sex and screening history (Fig. 2), it can be observed that men slightly adhere more than women to colonoscopy exam. Even the history of screening seems to have some influence on this indicator with a greater compliance of the subject at repeated screening, probably due to greater confidence in the program.

A complete scan of the colon is important because approximately 30% of carcinomas has a proximal location. For the Local Health Unit Livorno in the period under review the total of observed values are maintained at levels around the acceptable standard (GISCoR standards are: > 85% acceptable, > 90% desirable).

In Figure 3 and Figure 4 global Detection Rates (DR) (first screening + repeated screening) are presented for a need for

**Tab. I.** FOBT Positivity rates. Period 2000-2011: trends overtime and comparison with the average of the Tuscany Region.

Year	LHU 6		T.R.	
	First screening	Repeated screening	First screening	Repeated screening
2000	8,8		5,7	
2001	6,8		5,8	
2002	6,3		5,0	
2003	4,2	4,5	5,2	4,0
2004	4,2	3,7	4,7	3,8
2005	4,7	3,8	5,1	4,1
2006	4,0	3,1	5,2	3,9
2007	4,2	3,4	5,0	3,9
2008	4,8	4,4	5,2	4,3
2009	4,3	3,9	5,2	4,1
2010	4,0	4,1	5,4	4,0
2011	3,5	3,8	4,8	4,0

**Fig. 1.** Compliance to colonoscopy. Period 2000-2011 (first screening + repeated screening): temporal trends and comparison with the average of the Tuscany Region.

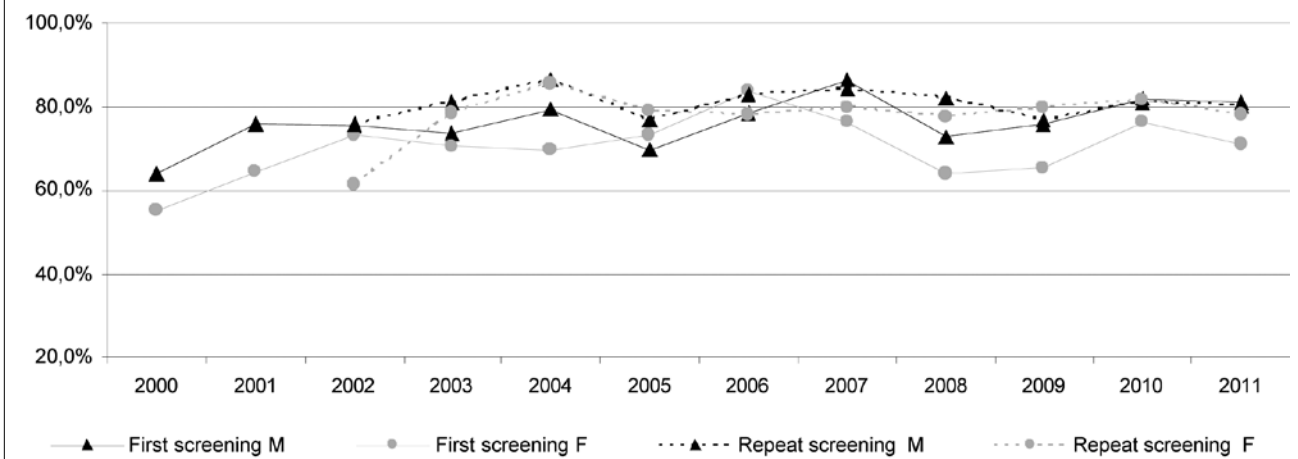


comparison with the regional average and a relatively low number of cases. Detection Rates adjusted for the compliance to colonoscopy are also calculated in order to allow a better comparison between years and to highlight the contribution of this to the overall effectiveness of the program. In the early activation of the screening program in Local Health Unit Livorno the highest values of DR for cancer and advanced adenoma had been observed, in line with the regional average and compatible with the initial phase of a screening program. It is evident from the graphs that the rates recorded in Livorno are consistently lower than the regional average, even after adjustment for compliance to colonoscopy and that there is, as expected, a trend to a decrease in the time of the DR for cancer (Fig. 3). A variability in the years of the DR for cancer and advanced adenoma is also noted; a different age distribution of the populations screened, as the data is not standardized for age, but also the low number of cases could contribute to this.

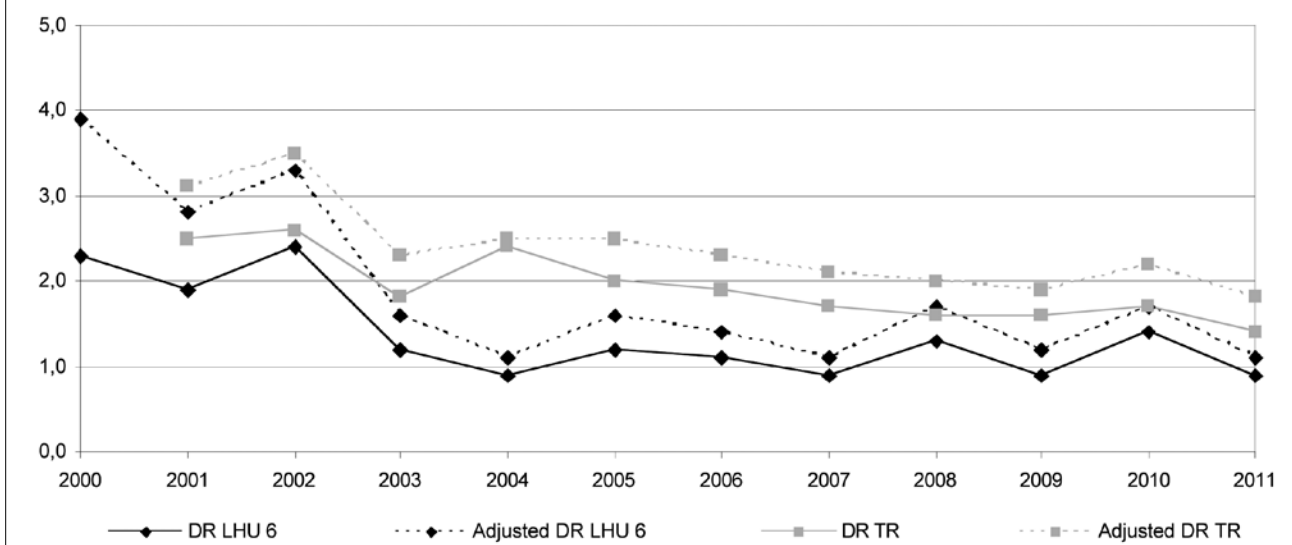
The PPV for cancer and advanced adenoma is consistently higher than that of simple adenomas during the period under consideration (Fig. 5). The analysis of the period under review showed, as expected, a very slight decline in the predictive power for cancer and a slight increase of the predictability for advanced adenoma and simple adenoma.

Overall, in 12 years of activity of colorectal cancer screening in the territory of Livorno were diagnosed 1051 simple adenomas, 1389 advanced adenomas and 285 invasive adenocarcinomas. For a significant proportion of cases (no. 75) it was not possible to retrieve information about the stage (Tab II). The distribution by stage of diagnosed cases, however, shows that just under half of these have been identified at the STAGE I, while the proportion of cases in STAGE III+ is 14.4%, definitely within the desirable GISCoR standard (GISCoR standard: acceptable < 30%; desirable < 20%). If the analysis is performed only on cases with known stage (Fig. 6) the

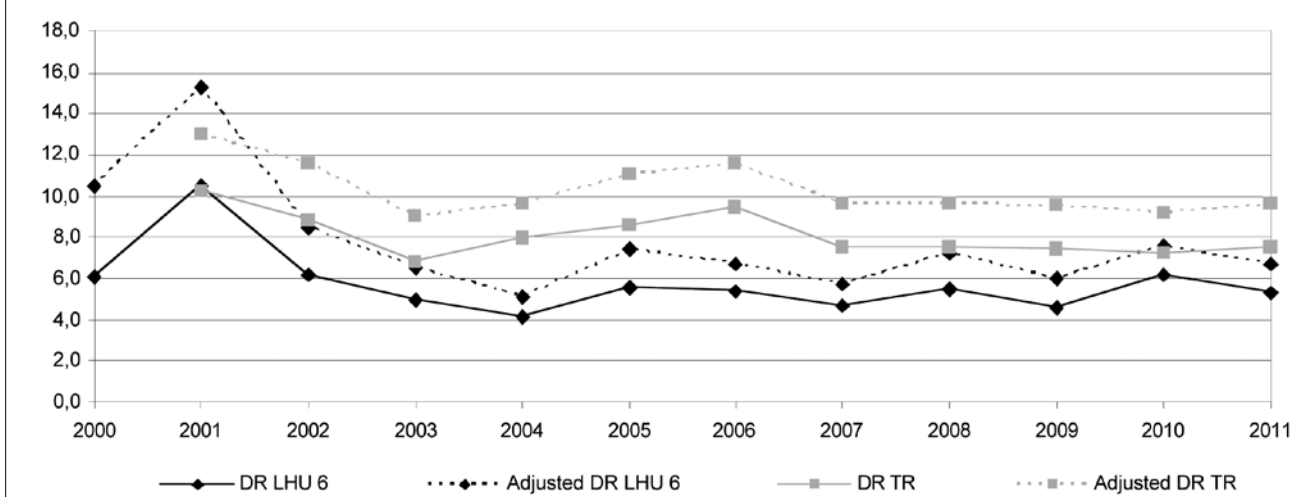
**Fig. 2.** Compliance to colonoscopy. Period 2000-2011 by sex and history of screening.



**Fig. 3.** Detection Rate (raw DR x 1.000 ) for cancer. Period 2000-2011 (first screening + repeated screening): temporal trends and comparison with the average of the Tuscany Region.



**Fig. 4.** Detection Rate (raw DR x 1,000) for advanced adenoma. Period 2000-2011 (first screening + repeated screening): temporal trends and comparison with the average of the Tuscany Region.



proportion of cases in STAGE I rose to 58.1% and that of cases STAGE III+ to 19.5% always remaining within the desirable GISCoR standard.

The criteria for the definition of colorectal cancer stage according to the TNM classification is summarized in Table III.

## Discussion

The analysis of the principal indicators includes a large period of time that allows to identify specific trends over time for all phases of the screening program. Extension and compliance are optimal and, especially for the extension, the values attest a consistent achievement of the target with the best performance among the regional and national scenario. “The compliance to the colonoscopy

is one of the key parameters to assess the impact of the program and its efficiency in reducing mortality” [8]. Its performances affect the overall diagnostic yield of screening intervention. The proportion of colonoscopies performed on the total number of FOBT positive subjects remains a critical point of the system at both local and regional level and should be the aim of all possible organizational efforts. The latest survey of the National Screening Observatory [9], indicates a national compliance rate to colonoscopy of 81,4%, not far from the recorded data in Local Health Unit Livorno and Tuscany Region [10]. A suboptimal compliance to the exam has a negative impact on the effectiveness of screening, because it leads to a loss of a portion of cancers and advanced adenomas that will not be diagnosed. A part of the non-compliance can be explained by the investigations carried out outside of the screening circuit, for which serve an organizational

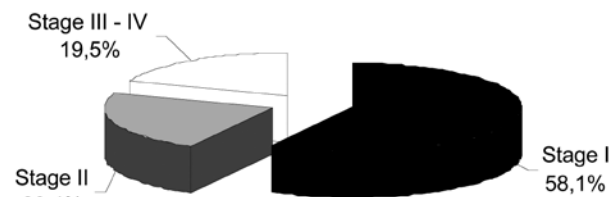
effort for the recovery of information. A part, however, is attributable to a lack of education on the screening program and should be improved through training the general practitioners and implementing the attention to counselling subjects resulting FOBT positive. This is a weak point of the program that can invalidate a substantial part of the expected benefit, and therefore deserves special attention.

The difference between raw and adjusted detection rate confirmed as a high adhesion to colonoscopy optimize the program efficiency, minimizing the missed diagnosis of advanced lesions and adenocarcinomas of the colon and rectum. The detection rate for cancer and for advanced adenomas is lower than the regional average, and this result does not seem explained by the low compliance to colonoscopy. The DR consistently lower than the regional average are not easy to interpret: they could be due to loss of cases or errors/incomplete registration, but it is not excluded that since low rates of DR are also recorded in neighbouring areas of Livorno [11] they are related to a different incidence/prevalence of disease in this area. It would be useful to carry out a specific survey on the different ways of classifying lesions and registration of data from other areas of Tuscany

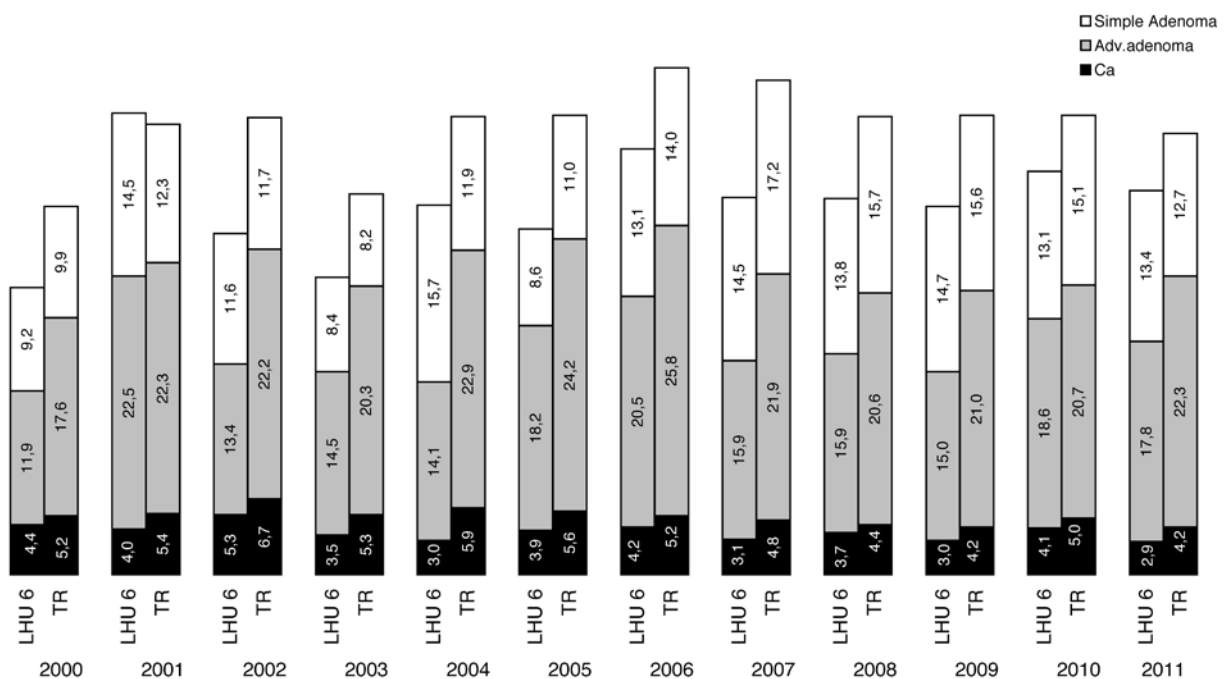
**Tab. II.** Stage at diagnosis of screen-detected cancer in the period 2000-2011 (first screening + repeated screening).

Year	N° of cancers	Stage I	Stage II	Stage III-IV	Unknown
2000	17	6	2	3	6
2001	24	10	3	3	8
2002	26	12	3	5	6
2003	24	10	4	2	8
2004	21	6	2	5	8
2005	23	10	5	3	5
2006	22	10	2	4	6
2007	21	10	4	1	6
2008	30	13	7	5	5
2009	24	13	3	5	3
2010	32	18	6	2	6
2011	21	4	6	3	8
<b>Total</b>	<b>285</b>	<b>122</b>	<b>47</b>	<b>41</b>	<b>75</b>
<b>%</b>	<b>100%</b>	<b>42,8%</b>	<b>16,5%</b>	<b>14,4%</b>	<b>26,30%</b>

**Fig. 6.** Distribution by stage at diagnosis of screen-detected carcinomas in the 2000-2011 period. Cases with known stage.



**Fig. 5.** Positive Predictive Value (PPV x 100) for cancer, advanced adenoma and simple adenoma. Period 2000-2011 (first screening + repeated screening): temporal trends and comparison with the average of the Tuscany Region.



**Tab. III.** Stage of colorectal cancer according to the TNM classification.

<b>Stage I</b>	T1 or T2, N0, M0
<b>Stage II</b>	T3 or T4, N0, M0
<b>Stage III</b>	Lymph nodes or distant metastasis
<b>Stage IV</b>	

Region, in order to verify whether this anomaly can be traced, in whole or in part, to a selection bias of information. It is possible, once removed this suspicion, that this result is attributable to epidemiological differences that should be investigated.

Looking at the data of PPV confirms what has already been stated in the GISCoR Manual [8], i.e., the ability of the test to select subjects with significant lesions (cancer and advanced adenoma). Overall, in about a fifth of colonoscopies performed significant lesions are diagnosed. The distribution by stage of screen-detected cancers in the period proves an excellent diagnostic anticipation of the screening program in the Local Health Unit. n. 6 of Livorno. As a reference, in 2011 the stage distribution of screen-detected cancers in Tuscany Region is 46.6% of cases diagnosed in STAGE I and 17% of cases STAGE III+ [10]. The national data reported in the 10th Report of National Observatory Screening [9], calculated on cases with known stage, presents a proportion of cancers diagnosed in STAGE I ranging from 36.1% (at first screening) to 43.2% (at repeated screening) and a percentage of cases STAGE III - IV from 27.1% (at first screening) to 25.4% (at repeated screening).

## Conclusions

The comprehensive analysis highlights the good performance of the Livorno screening program over the years. The proportion of colonoscopies performed on the total number of positive subjects remains a critical point of

the system. The distribution by stage of screen-detected cancers shows an excellent diagnostic anticipation of the screening program.

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