A shortcut to Rome: Exploring the Social Determinants of patients' Time to Diagnosis

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A shortcut to Rome: Exploring the Social Determinants of patients' Time to Diagnosis

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Abstract

In this study, we measure time to diagnosis defined as the timespan from first symptoms to final diagnostic for four chronic conditions, and analyze the role played by patients social characteristics in accounting for time to diagnosis. We use self-reported data from an online open access questionnaire administered to a large French social network of patients with chronic conditions. Duration models were used to explain variations in time to diagnosis. The results suggest that social participation and social support reduce the probability of experiencing longer periods of time to diagnosis. Higher levels of education, on the contrary, increase the probability of experiencing longer period of time to diagnosis. We further analyze this result by identifying differences in health care-seeking behavior: more educated patients tend to first consult specialists, which is correlated with a longer time to diagnostic work-up. Indeed, ambulatory care specialists are less likely than GPs to refer patients to hospitals for additional tests, when needed. The findings on social capital support WHOs recommendations to enhance individual social capital as this could reduce the time period needed to obtain a final diagnosis. In addition, our results on education suggest that public interventions aimed at optimizing healthcare pathways through a GP referral system for specialists services may reduce period of time to diagnosis.

Keywords: Chronic disease, Diagnosis, Education, Health inequalities, Social capital

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1. Introduction

Delays in diagnosis may have detrimental outcomes in terms of health and avoidable health expenditures. Despite diagnosis innovative technologies, and the standardization of diagnosis and treatment protocols, the time elapsed between first symptoms and final diagnosis vary substantially across patients. The French survey Erradiag, conducted in 2016, showed that 25% of patients treated for a rare disease assessed a time to diagnosis over 5 years[1]. Nearly 60% declared that lack of diagnosis led to physical harm, psychological distress, and avoidable medical treatments. Moreover, several medical studies conducted on cancer patients showed that time to diagnosis was negatively correlated to survival time (Richard et al. (2000); Facione (1993); Ramos et al. (2007)). The pre-diagnosis period has important consequences on prognosis and disease progression and if linked to social status, may play an important role in the construction of social health inequalities. However, it has so far received little attention in the academic literature. In this paper, we study the pre-diagnosis stage of illness, from the patients perspective. Our main variable if interest is time to diagnosis defined as the time elapsed between first symptoms appearance and final diagnosis. Variations in time to diagnosis may reflect supply side effects (the healthcare systems responsiveness to symptoms' onset), as well as demand side effects, driven by patients characteristics and healthcare seeking behavior. We describe time to diagnosis among patients treated for four chronic diseases, bipolar trouble, Crohn disease, multiple sclerosis and psoriasis, then explore socioeconomic factors that may explain differences in time to diagnosis, with an emphasis on education and individual social capital as those variables have been shown to have important causal effects on health status, health behaviors, and

[1] Erradiag survey conducted by Alliance Maladies rares in 2016. Report available online at: http://fr.calameo.com/read/003972817bb7d085cce09

health utilization behaviors (Li and Powdthavee (2015); Hummer and Lariscy (2011); Kawachi et al. (2008)).

We base our research on an online survey administered to patients participating to a social network dedicated to chronic conditions. The results show that individual characteristics, among which social capital and education, have strong and significant impacts on time to diagnosis, shedding a new light on the construction of social health inequalities. The paper is organized as follows. Section 2 reviews the literature on diagnosis making, and on the channels through which social capital and education may influence time to diagnosis. Section 3 introduces the questionnaire and the data. Section 4 presents the statistical methods, section 5 presents our main results which we discuss in section 6.

2. Literature Review

This study aims at investigating how education, social capital and individual preferences may affect time to diagnosis and how the pre-diagnosis period can contribute to the construction of social inequalities in health. In this section, we describe how time to diagnosis, and the links between health / healthcare utilization and each of these factors have been addressed in the literature.

The time elapsed between first symptoms and first medical encounter varies with symptoms specificity and severity. If the symptoms are nonspecific [2], the patient may confuse them with transient episodes of tiredness or anxiety. On the contrary, severe symptoms, sometimes combined with disabilities, foster the decision to seek care and reduce the time to first contact with medical doctor (Fajardy and Michel (2012)). After the patients first contact with the healthcare

[2] An nonspecific symptom is one that does not identify uniquely a disease. It could be that the symptom affects multiple organs and body parts at the same time, or affects the body as a whole as pain or fatigue. The nature of symptoms onset complicates the clinical and pathologic investigation of patients' features.

system, a thorough examination is critical in converging to a diagnosis. Yet, the disease may be in an early stage, or again, the symptoms maybe nonspecific. Moreover, illnesses such as multiple sclerosis or lupus, are characterized by relapsing-remitting forms, for which symptoms may disappear suddenly. In complex illnesses, diagnosis is harder to attain and errors more frequent. Health professionals must adjust the diagnosis strategy, weighing the benefits and downsides of more examinations, so as to produce a precise diagnosis, and take into account the costs for the patient (invasive procedures, anxiety, with negative impacts on their compliance to treatment) (Fuat et al. (2003)). In cases where symptoms are common to more than one disease, health professional may fail to identify the proper illness. From the results of the survey conducted in 2012 by the French Observatory for rare diseases[3], 90% of ambulatory doctors and other health professionals lack knowledge on rare diseases. Moreover, due to increasing specialization, doctors may lack a global approach to patients health, which may hamper diagnosis when the disease involves several medical specialties. Indeed, while increased specialization may have positive effect on health care and health outcomes for diseases within the area of specialty, increased specialization may induce coordination failures when the diseases involve multiple medical disciplines (Baicker and Chandra (2004)).

Patients characteristics appear also to be linked with time to diagnosis. An extensive literature has established the link between education and health, often referred to as the health education gradient. Results indicate that more educated people have healthier behaviors, have better health status, and higher life expectancy (Grossman (1972); Cutler and Lleras-Muney (2010); Johnston et al. (2015)). Education is associated with better access to services and finan-

[3]Survey conducted by the French Observatory for rare diseases in 2012. Report available online at: (http://www.maladiesraresinfo.org/assets/pdf/Rapport_Observatoire_maladies_rares_2012.pdf

cial support, which reduces financial stress and facilitates access to health care (Oreopoulos (2006); Devereux and Hart (2010)). They show higher competencies to gain access, understand and use information in ways that promote and maintain good health often referred to as health literacy (Nutbeam and Kickbusch (2000); Nutbeam (2008)). The more educated tend to adopt healthier life styles, adhere and comply to medical decision and treatment, and reap the benefits of improved medical technology (Goldman and Smith (2002); Goldman and Smith (2011)) and health campaigns (Cooper et al. (2003); Gordon et al. (2006)). Futhermore, education is associated with better health related behavior such as lower cigarette consumption and higher level of physical exercice (De Walque (2007)). An additional year of schooling appears to reduce average daily cigarette consumption by 1.6 for men and 1.1 for women and to increase physical exercise on average by 17 minutes (Wolfe et al. (2002); Kenkel (1991)).

Moreover, socio anthropological studies show that more educated individuals also have different perceptions of their body and their healthcare needs and they seem to experience and report pain differently (Bonham (2001)). These results explain why less educated people may underuse health care services provided at no cost (Després et al. (2011)).

Studies on patient-doctor interaction suggest that the social proximity between patients and doctors influence diagnosis process, health care provision and sharing of information (Balsa and McGuire (2003); Balsa et al. (2005); Kelly-Irving et al. (2011)). Balsa and McGuire analyzed the way in which interactions between doctors and patients may contribute to disparities in health and suggested that patients relative positions affect doctors interpretations and decisions during the diagnosis process. Besides, studies conducted before acute coronary crisis showed that more investigation had been undertaken for better educated patients (Lang et al. (1998); Lang et al. (2011); Gerber et al. (2010)).

Patients education therefore appears to affect both healthcare seeking behaviors and healthcare professionals response. The pre-diagnosis period hence appears crucial in the construction of social health inequalities.

Beyond education, social relationships and networks may also play an important role in time to diagnosis inequalities. Social capital, developed by Coleman (1988), Bourdieu (1980), Putnam (1995), is a concept that had many different definitions over time, and is of growing interest for different fields from sociology to political science to economics and epidemiology. In health economics literature, social capital can be either approached at the collective level (society, communities) as "features of the social organizations such as trust, norms, and networks that can improve the efficiency of society by facilitating coordinated actions" (Putnam (1995)), or at the individual level.

In this paper, we refer to individual social capital: "individuals social characteristics that enable private returns via interaction with others that can be accumulated or transmitted across generations" (Glaeser et al. (2002); Rocco et al. (2014); Rocco and Fumagalli (2014)). Intensive interactions offer patients privileged channels of information transmission, the opportunity to share past experiences on health facilities, health services, health professionals, and this may both reduce patients informational costs (d'Hombres et al. (2010)) and provide social/financial support (Hawe and Shiell (2000)). Rocco et al. presented 4 different mechanisms that may account for the link between social capital and health: (1) Social capital may provide easier access to health relevant information as a result of more intense social interaction. (2) Social capital may facilitate the provision of informal health care and psychological support. (3) Social capital may facilitate peoples lobbying efforts to obtain health-enhancing goods and services. (4) Social capital may induce rational people to reduce their risky behavior by increasing the expected value of life (Rocco et al. (2014)). In

the period preceding the final diagnosis, benefits from such returns to social resources may facilitate interactions within the health care system, enable patients to get a better access to the healthcare system and rationalize care-seeking behaviors.

The role of individual preferences in decision-making has been widely investigated in economics (Anderson and Mellor (2008); Gafni and Torrance (1984)). Attitudes toward risk (Charness et al. (2013)), and time preferences, i.e. the preference for immediate over delayed satisfaction (Kahneman and Frederick (2002)), capture part of individual heterogeneity and are useful concepts for understanding and predicting economic behavior. Various approaches have been suggested to elicit individual preferences but little attention has been paid on their contribution to health and health related behavior disparities. Studies suggest that individuals with lower time preferences or less risk adverse individuals are more likely to undergo screening (Picone et al. (2004)). Jusot and Khlat (2013) provide evidence that time preferences and risk aversion are correlated with risky behaviors such as smoking. Their results also show a reduction of the educational gradient in smoking after controlling for these characteristics, supporting their role as partial mediators. Regarding access to health care, results from Picone et al. (2004) suggest that individuals with lower time preferences tend to delay care seeking, and be less proactive during the diagnosis making period because they underestimate the future losses associated with delayed access. Similarly, risk adverse individuals may fear the diagnosis and be less proactive during the diagnosis making period, and experience longer time to diagnosis. None of these hypotheses have been empirically tested, to the best of our knowledge, and such is the aim of our paper.

While many studies examined the isolated effect of education, social capital and individual preferences on health and health behavior, very few have consid-

ered these variables together. Yet, literature provides evidence that those social characteristics exhibit important correlations. Verba et al. (1995) show that more educated people engage more often in collective activities while Putnam and Helliwell (1999) show that education levels increase levels of trust, one of the commonly used proxy for social capital. Regarding individual preferences, the less educated are more likely to engage in riskier behaviors (Murphy and Topel (2006)).

3. Materials and Methods

Data

The study is based on patients assessments of time elapsed from first symptoms to final diagnosis. This information was collected from an online survey on a social network, Carenity[4], dedicated to chronic patients, between May and July 2015. Data collected are self-reported and retrospective. We checked the consistency of answers provided by patients by comparing values for age, age of symptoms' onset, date of first symptoms and final diagnosis date.

From completed questionnaires, 659 (78%) passed time the aforementioned coherence tests. Since the study focus is the impact of education and social capital on time period to diagnosis, patients aged less than 18 years old at the time of first symptoms were excluded. This has reduced the sample size to 503 patients, but enables us to concentrate on patients with autonomous behavior in health management and to exclude patients diagnosed at birth or in their childhood.

The questionnaire was developed using questionnaires from the main French health and insurance interview survey. Questions on the pre-diagnosis period

[4]Carenity is a social network dedicated to patients with chronic conditions (see https://www.carenity.co.uk/who-we-are

were designed to describe patients experience from symptoms appearance to final diagnosis. A pilot tested the questionnaires on a subsample of 21 patients.

The sample is not meant to be fully representative. Members of patients social networks are likely to differ from general population patients in terms of social and health characteristics. Besides, the survey being administered online, with an open access and no control on respondents environment, we suspect that patients with expanded pre-diagnostic periods could have been more eager to share their experience. The verbatim collected in the open question "What has been your experience of the healthcare system from symptoms appearance to final diagnosis?" shows indeed that some of the respondents described pre-diagnostic experience as chaotic.

The development of a chronic illness entails a substantial change in social life and professional career for patients and the literature suggests the period preceding final diagnosis should therefore be well remembered by patients (Talarico et al. (2004); Berney and Blane (1997)).

We selected patients suffering from multiple sclerosis, bipolar disorder, psoriasis, and Crohns disease. We chose these pathologies, first because they are heterogeneous in terms of severity and progression. Second, because clinical diagnosis is difficult to establish for these diseases, given the variety of symptoms. Thirdly, some of these diseases have serious repercussions on functional health and patients daily life. Finally, sufficient sub-samples of patients were available for these pathologies.

Multiple sclerosis is an inflammatory disease of the central nervous system characterized by sensation disorders and mobility impairments. The diagnosis is based on imaging analysis such as MRI scan. Prognosis is unpredictable, with long remission periods (McDonald et al. (2001)).

Bipolar disorders are characterized by maniac phases or recurring hypo-

mania and major depressive episodes. Addictions, isolation, divorce or unemployment are commonly associated with bipolar disorders. The risk of suicide is 15 times higher than in general population in France(Goodwin and Jamison (2007)). There is a ten-year lag, on average, between first symptoms and treatment initiation (Hättenschwilera et al. (2009)).

Psoriasis is a long-lasting autoimmune disease characterized by patches of abnormal skin. Diagnosis is typically based on the signs and symptoms and difficult to establish. Psoriasis is associated with an increased risk of psoriatic arthritis, lymphomas, cardiovascular disease, Crohns disease, and depression. Psoriatic arthritis affects up to 30% of individuals with psoriasis (Gelfand et al. (2005)).

Crohns disease is a type of inflammatory bowel disease (IBD) characterized by inflammatory and remission phases. Symptoms include abdominal pain, diarrhea, fever and weight loss. Diagnosis is based on the addition of several tests including biopsy and bowel wall examination. Delayed diagnosis may lead to severe complications (Van Assche et al. (2010)).

Variables used in the analysis

The variable *Time to diagnosis* (in months) captures the time elapsed between first symptoms and final diagnosis. It is calculated from respondent assessment of first symptoms and final diagnosis dates.

The variable *Education* is derived from the highest educational attainment reported by patients, regrouped into 3 categories: no diploma or technical degree, baccalaureate (corresponding to the high school final degree in France), and undergraduate level or more.

We used two variables to proxy the level of social capital: *Social Participation* is a dummy variable that measures patients participation to collective activities

such as voluntary-charity work, training courses, sport-social clubs, religious organizations, and political-community organizations. *Social support* is a dummy variable that accounts for the support the respondent may benefit from relatives in case of problems. These variables are the most commonly used variables to capture individual social capital (Scheffler et al. (2007); Olsen and Dahl (2007)). Information on symptoms severity was also collected to control for clinical manifestations using a categorical variable $Symptoms'\ severity$ corresponding to mild, moderate or severe symptoms.

Individual preferences were collected using standardized questions developed and validated by IRDES for the French Health Healthcare and Insurance Survey 2008. The $Time\ preference$ and risk aversion variables were derived from scores assessed by respondents on a 0 to 10 scale. These scales were elaborated in the INSEE-DELTA survey (Arrondel et al. (2004b); Arrondel et al. (2007)) which aimed at measuring time and risk preference measures (Arrondel et al. (2004a); Arrondel and Masson (2014)). From the scores, we constructed dichotomous variables (0,1,2/310 for time preference and 0-7/8-10 for risk aversion, following Jusot and Khlat (2013).

The *First medical contact* may either be a GP, the hospital specialist, the ambulatory care specialist, and A & E departments.

Table 1 displays respondents socioeconomic characteristics by type of disease. Table 2 reports the distribution of time to diagnosis by disease and displays large discrepancies between and within illnesses. As we can observe in table 1, women represent the majority of the sample (77%): this feature is consistent with the overrepresentation of women in online social networks (Correa et al. (2010)), and the higher representation of multiple sclerosis (Chwastiak et al. (2002)) and bipolar trouble (Llorca et al. (2013)) among women. Respondents were also on average more educated and younger, also corresponding to findings

on social media usage (Correa et al. (2010)). Looking at the distribution of time to diagnosis, we observe very skewed distributions toward 0 (less than 1 month of time to diagnosis) with very large extreme values (maximum of 20 years of time to diagnosis for psoriasis to 35 years for bipolar trouble). We do observe large variations in time to diagnosis within and between each of the chronic condition. Patients with bipolar trouble exhibit on average a longer time to diagnosis (7,5 years), with a maximum value of 35 years.

Table 1: Patients' sociodemographic characteristics

	Medical conditions				
	Psoriasis	**Multiple sclerosis**	**Bipolar trouble**	**Crohn disease**	**Total**
	Col %	Col %	Col %	Col %	Col %
Sexe					
Homme	36.6	19.9	24.3	17.5	23.3
Femme	63.4	80.1	75.7	82.5	76.7
Age group					
18-34	4.9	12.4	8.7	33.8	13.7
35-44	15.9	22.1	26.1	27.5	22.9
45-54	31.7	33.2	39.1	18.8	32.0
¿55	47.6	32.3	26.1	20.0	31.4
Couple					
Non	42.7	37.6	50.4	37.5	41.4
Oui	57.3	62.4	49.6	62.5	58.6
Education					
No diploma	40.2	32.3	20.0	35.0	31.2
Baccalaureate	14.6	22.1	20.9	12.5	19.1
Bac+2 and +	45.1	45.6	59.1	52.5	49.7
Social participation					
No	82.9	75.2	82.6	82.5	79.3
Yes	17.1	24.8	17.4	17.5	20.7
Social support					
No	46.3	38.1	53.9	40.0	43.3
Yes	53.7	61.9	46.1	60.0	56.7
N	82	226	115	80	503

Table 2: TIME TO DIAGNOSTIC WORK-UP BY DISEASE
(IN MONTHS)

Disease	N	Mean	SD	p25	p50	p75	Min	Max
Psoriasis	82	35.5	71.1	2	4	34	0	366
Multiple sclerosis	226	37.3	64.1	3	10	46	0	386
Bipolar trouble	115	90.5	90.8	7	68	150	0	420
Crohn disease	80	24.6	44.0	3	6.5	26.5	0	239
Total	503	47.2	73.6	3	12	57	0	420

Source: Authors data.
Table legend: Time to diagnostic is defined as the time span between symptoms appearance and final diagnostic in months. Statistics displayed are respectively: (1) Number of observations; (2) Mean ; (3) Standard deviation; (4) First quartile; (5) Median; (6) Third quartile; (7) Minimum; (8) Maximum.

Methods

We studied the links between time to diagnosis and our variables of interest (education, social capital) accounting for demographic, risk and time preferences, and severity differences between respondents. We used a Cox proportional hazard model (Cox (1992)) to analyze time to diagnosis, using Breslow method for ties. Time to diagnosis (in months) was used as our time scale. This semi-parametrical procedure allows us to compute the baseline hazard function h(t) which is the probability of failure -here, the diagnosis in the next step, given that diagnosis was not available at time t, without any restrictive distributional assumptions. The Cox model assumes that covariates are multiplicatively related to the hazard (ie. proportional hazard assumption) but this hypothesis appears to be refuted for Age Class, as young patients experienced on average lower time to diagnosis compared to older patients in our sample.

We therefore used an extension of the Cox model to deal with non-proportional hazards by stratifying over the covariate *Age Class* that does not satisfy the proportional hazard assumption. The extension allows for multiple strata with distinct baseline hazard function but common values for the coefficient vector . Our model specifies 4 strata corresponding to the 4 categories of *Age class*

(18-34 years old; 35-44 years old; 45-54 years old; >55 years old) as displayed in Table 1.

The model for each strate is written:

$$h_g(t) = h_{0g}(t)exp[\beta_1 X_1 + ... + \beta_p X_p]$$

with g $\in \{1, 2, 3, 4\}$, strata defined from *Age Class*

Using this specification, we measure the effect of both education and social capital on the probability of survival, which here represents the probability to remain without diagnosis (the event of the survival analysis is obtaining the final diagnosis). The fully adjusted models included controls for gender, marital status and symptoms severity. We added controls and clustered errors for medical conditions to account for heterogeneity across diseases. The vector X hence designate the following variables: *Education*, *Social Participation*, *Social Support* and the aforementioned control variables gender, marital status, symptoms severity and medical condition.

4. Results

Table 3 reports estimates for the models (1), (2), (3). The results from Cox stratified models show that social capital, as measured by social participation and social support is significantly associated with longer time to diagnosis. Patients reporting social support or social participation exhibit hazard ratios superior to 1, meaning that social support significantly reduces the probability to have a longer time to diagnosis (Table 3 Model (1), HR respectively 1.21, $p<0.05$ and 1.27, $p<0.000$). This finding is robust to the inclusion of control variables accounting for time and risk preferences (Table 3 Model (2) and Model (3)).

More educated patients have a higher probability to experience longer time

Table 3: Estimated coefficients and 95% confidence intervals for covariates' incidence on time to diagnostic work-up using Cox model stratified by Age Class.

	(Model 1)	(Model 2)	(Model 3)
Female	-0.138	-0.148	-0.123
	(-1.64)	(-1.91)	(-1.78)
Couple	0.0506	0.0403	0.0835
	(0.49)	(0.40)	(0.87)
Education (Ref=No diploma)			
Baccalaureate	-0.0237	-0.0471***	-0.0476
	(-0.89)	(-3.98)	(-0.64)
Bac+2 and +	-0.0548**	-0.0714**	-0.0601
	=(-2.74)	(-3.13)	(-1.55)
Social support	0.189*	0.199**	0.221***
	(2.34)	(2.82)	(3.31)
Social participation	0.240***	0.244***	0.268***
	(4.93)	(4.81)	(4.01)
Disease (Ref=Psoriasis)			
Multiple sclerosis	-0.0659	-0.0560	-0.143
	(-0.63)	(-0.56)	(-1.26)
Bipolar trouble	-0.660***	-0.640***	-0.715***
	(-30.95)	(-18.13)	(-19.25)
Crohn disease	0.0469	0.0650	-0.0507
	(0.85)	(1.15)	(-0.63)
Symptoms' severity (Ref=Mild)			
Moderate	-0.0397	-0.0662	-0.0338
	(-0.17)	(-0.26)	(-0.15)
Severe	-0.0654	-0.101	-0.0915
	(-0.39)	(-0.51)	(-0.47)
Risk aversion		-0.147	-0.159
		(-0.90)	(-0.87)
Pref. for present		-0.0551*	-0.0706***
		(-1.96)	(-5.42)
First medical contact (ref=GP)			
Hospital specialist			-0.0871
			(-1.15)
Ambulatory specialist			-0.513**
			(-2.65)
Emergency service			-0.126
			(-0.50)
Observations	503	503	503

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

to diagnosis compared to patients without diploma (Table 3, Model (1), HR 0.95 for individuals with a College degree, $p<0.01$). After controlling for individuals risk aversion and time preferences (Table 3, Model (2)), coefficients for *Education* remain constant and significant. Preference for the present appears to significantly increase the probability of longer time to diagnosis. Table 3, Model (2), HR 0.95, $p<0.05$), while the coefficient for risk aversion remains insignificant.

Having an ambulatory specialist visit as first medical contact increases significantly the probability of having a longer time to diagnosis (Table 3, Model (3), HR 0.60, $p<0.01$). Moreover, after controlling for type of first medical contact, the coefficient for *Education* becomes insignificant, providing evidence that education was previously impacting the probability of having a longer time to diagnosis through the choice of the first medical contact.

This result is robust to the inclusion of control variables accounting for individual risk and time preference. It is also robust to the exclusion of the 3% extremes values of our sample, which reduces the maximum value of time to diagnosis from 420 months to 262 months (see table 4 in Appendix, Model (4)). We also remove from the sample individuals that have been diagnosed recently, respectively 1 year and 2 years before; the results are robust to this robustness check (see table 4 in appendix, Model (5)). Finally, we test the hypothesis of proportional hazard for our stratified Cox model: proportionally of hazard was not rejected significantly ($p>0.67$), supporting our specification.

5. Conclusion

Stronger social participation and social support significantly reduce time to diagnosis (Table 3, Model (3): HR respectively 1.25, $p<0.001$; 1.31, $p<0.000$). Social interactions may allow patients to gather health information as well as

information from other patients, thereby reducing time to diagnosis. Social capital also facilitates access to social and financial support.

Regarding individual preferences, only high preferences for the present were associated with a higher probability of longer time to diagnosis (Table 3, Model (3): HR 1.25, $p<0.001$). The result on preferences for the present is in line with previous findings (Picone et al. (2004)): patients with higher preferences for present are substantially more focused on present well-being and may be less proactive in the diagnosis-seeking process. Such patients may undervalue future losses associated with postponing a medical consultation or a less proactive behavior during the pre-diagnosis period. They may also favor procrastination, i.e. value ignorance over awareness, postponing examinations they fear may reveal a pathology (Rapp (2014)).

Higher levels of education increase the probability of longer time to diagnosis (Table 3, Model (1), HR on college degree: 0.95, $p<0.01$). Even after controlling for risk aversion and preference for the present (Table 3, Model (2)), the coefficients for *Education* remain constant and significant. We identify four possible channels to account for this result.

1- More educated patients can more easily challenge medical doctors assessments (Lupton (1997); Smith et al. (2009)), hence seek expertise from more health professionals. Besides, doctors could behave differently when patients are more educated, knowing they are proactive and may challenge their diagnosis (Willems et al. (2005)). Doctors could tend to gather more evidence before giving their final diagnosis, to avoid diagnosis errors.

2- As more educated patients consult specialists more readily than GPs (Le Fur and Yilmaz (2008), Gouyon (2010)). Ambulatory care specialists, unlike GPs, tend to delay patients referring to hospitals or emergency services (Friedberg et al. (2010); Foot et al. (2010); Johnson et al. (2008)), which can in

turn increase time to final diagnosis.

3. Finally, educated patients may retrospectively assess symptoms appearance earlier than less educated individuals, and differences in bias in self-reported dates may drive the results on education as they have higher expectations about their health status (Allin et al. (2010); D'Houtaud and Field (1984)) and as their exists socioeconomic variation in pain tolerance (Bonham (2001))

Whereas we were not able to collect information on patients or doctors behavior regarding this period, which prevents us from further investigating explanations 1, 3 and 4, we can test the second hypothesis on our dataset.

Results suggest differences in health care-seeking behavior as the coefficient on *Education* looses significance (Table 3, Model (3): HR respectively 0.94, $p>0.1$) and the one associated with specialists turns out to be significant (Table 3, Model (3) : HR 0.60, $p<0.01$): the more educated patients tend to first consult specialists, which is correlated with a longer time to diagnosis. Indeed, ambulatory care specialists are less likely than GPs to refer patients to hospitals for additional tests, when needed. These results provide evidence that first medical contact is determinant for health trajectories until a diagnosis is obtained. Hence, the results raise the question of the role of primary medicine and provide support for current public policies aimed at establishing coordinated and streamlined healthcare pathways, with GPs as gatekeepers, as health trajectories and outcomes have been showed to be affected by differences in access to diagnosis for the considered chronic diseases. Delays in time to diagnosis, not solely patients responsibility, are an underdocumented aspect of the fight against health inequalities. Potential leverage for their reduction must be further explored in academic research to refine health care practices and organization.

The study has several limitations, First, since questionnaires were kept rea-

sonably short to ensure good response rates and avoid excessive burden for respondents, we did not include questions on disease history as well as symptoms evolution, and as a result, controls for disease severity lack precision as we only collected patients perception of symptoms severity in the early phase of the time to diagnosis. Moreover, no information was collected on patients incomes and the characteristics of the patient-doctor relationship, which may shape access to healthcare services as well as diagnosis-seeking strategies.

To address possible reverse causality issue, we chose to remove patients with symptoms occurring before 18 years old, which ensures inclusion of patients with autonomous behavior in health decisions. Yet, this method only partially answers the endogeneity issue since the time to diagnosis may have implications on educational achievements. Finally, we lacked data to model and estimate the determinants of patients decision to consult, which would contribute towards understanding patients decisions to seek care and their disease management strategies.

Despite these limitations, we were able to document large variations between patients and between conditions for four chronic conditions. We also documented a strong effect of social participation, social support, and education on time to diagnosis. These results point to the existence of socio-economic inequalities in patients pathways to diagnosis which had not been analyzed so far in the literature, and shed a first light on the role of the pre-diagnosis period in the construction of social health inequalities.

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Appendix

Table 4: Robustness checks: Model (4): coefficients for model (3) without 3% top values and Model (5) displays coefficients for Model (3) restricting for patients diagnosed within the 2 previous years

	(Model 4)		(Model 5)	
Female	-0.0976	(-1.53)	-0.158	(-1.93)
Couple	0.101	(0.88)	0.0606	(0.64)
Education (Ref=No diploma)				
Baccalaureate	-0.0946	(-1.17)	-0.0504	(-0.47)
Bac+2 and +	-0.0587	(-0.85)	-0.0520	(-1.07)
Social support	0.154***	(4.74)	0.248***	(4.05)
Social participation	0.174*	(2.52)	0.278***	(3.87)
Disease (Ref=Psoriasis)				
Multiple sclerosis	-0.355***	(-5.17)	-0.135	(-1.11)
Bipolar trouble	-1.037***	(-11.01)	-0.695***	(-18.67)
Crohn disease	-0.374***	(-4.13)	-0.0562	(-0.66)
Symptoms' severity (Ref=Mild)				
Moderate	-0.0149	(-0.09)	-0.0821	(-0.35)
Severe	0.000401	(0.00)	-0.139	(-0.75)
Risk aversion	-0.0877	(-0.51)	-0.219	(-1.27)
Pref. for present	-0.236***	(-3.42)	-0.0420*	(-2.43)
First medical contact=1	0	(.)	0	(.)
Hospital specialist	-0.0672	(-0.83)	-0.120	(-1.38)
Ambulatory specialist	-0.413*	(-2.55)	-0.536**	(-2.95)
Emergency service	-0.000556	(-0.00)	-0.148	(-0.54)
Observations	489		474	

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

References

Allin, S., Grignon, M., Le Grand, J., 2010. Subjective unmet need and utilization of health care services in canada: what are the equity implications? Social science & medicine 70 (3), 465–472.

Anderson, L. R., Mellor, J. M., 2008. Predicting health behaviors with an experimental measure of risk preference. Journal of health economics 27 (5), 1260–1274.

Arrondel, L., Masson, A., 2014. Mesurer les préférences des épargnants: comment et pourquoi (en temps de crise)? Economie et statistique 467 (1), 5–49.

Arrondel, L., Masson, A., Verger, D., 2004a. Mesurer les préférences individuelles à l'égard du risque. Économie et statistique 374 (1), 53–85.

Arrondel, L., Masson, A., Verger, D., 2004b. Préférences de lépargnant et accumulation patrimoniale. dossier de 5, 374–375.

Arrondel, L., Masson, A., et al., 2007. Inégalités patrimoniales et choix individuels: des goûts et des richesses. Tech. rep.

Baicker, K., Chandra, A., 2004. The productivity of physician specialization: Evidence from the medicare program. American Economic Review 94 (2), 357–361.

Balsa, A. I., McGuire, T. G., 2003. Prejudice, clinical uncertainty and stereotyping as sources of health disparities. Journal of health economics 22 (1), 89–116.

Balsa, A. I., McGuire, T. G., Meredith, L. S., 2005. Testing for statistical discrimination in health care. Health services research 40 (1), 227–252.

Berney, L. R., Blane, D. B., 1997. Collecting retrospective data: accuracy of recall after 50 years judged against historical records. Social science & medicine 45 (10), 1519–1525.

Bonham, V. L., 2001. Race, ethnicity, and pain treatment: Striving to understand the causes and solutions to the disparities in pain treatment. The Journal of Law, Medicine & Ethics 28 (4_suppl), 52–68.

Bourdieu, P., 1980. Le capital social. Actes de la recherche en sciences sociales 31 (1), 2–3.

Charness, G., Gneezy, U., Imas, A., 2013. Experimental methods: Eliciting risk preferences. Journal of Economic Behavior & Organization 87, 43–51.

Chwastiak, L., Ehde, D. M., Gibbons, L. E., Sullivan, M., Bowen, J. D., Kraft, G. H., 2002. Depressive symptoms and severity of illness in multiple sclerosis: epidemiologic study of a large community sample. American Journal of Psychiatry 159 (11), 1862–1868.

Coleman, J. S., 1988. Social capital in the creation of human capital. American journal of sociology 94, S95–S120.

Cooper, H., Booth, K., Gill, G., 2003. Patients perspectives on diabetes health care education. Health education research 18 (2), 191–206.

Correa, T., Hinsley, A. W., De Zuniga, H. G., 2010. Who interacts on the web?: The intersection of users personality and social media use. Computers in Human Behavior 26 (2), 247–253.

Cox, D. R., 1992. Regression models and life-tables. In: Breakthroughs in statistics. Springer, pp. 527–541.

Cutler, D. M., Lleras-Muney, A., 2010. Understanding differences in health behaviors by education. Journal of health economics 29 (1), 1–28.

De Walque, D., 2007. Does education affect smoking behaviors?: Evidence using the vietnam draft as an instrument for college education. Journal of health economics 26 (5), 877–895.

Després, C., Dourgnon, P., Fantin, R., Jusot, F., 2011. Le renoncement aux soins pour raisons financières: une approche économétrique. Irdes, Questions déconomie de la santé 170.

Devereux, P. J., Hart, R. A., 2010. Forced to be rich? returns to compulsory schooling in britain. The Economic Journal 120 (549), 1345–1364.

d'Hombres, B., Rocco, L., Suhrcke, M., McKee, M., 2010. Does social capital determine health? evidence from eight transition countries. Health economics 19 (1), 56–74.

D'Houtaud, A., Field, M. G., 1984. The image of health: variations in perception by social class in a french population. Sociology of Health & Illness 6 (1), 30–60.

Facione, N. C., 1993. Delay versus help seeking for breast cancer symptoms: a critical review of the literature on patient and provider delay. Social science & medicine 36 (12), 1521–1534.

Fajardy, I., Michel, H., 2012. Difficultés diagnostiques de lhémochromatose génétique hfe (retard, excès, absence): point de vue du malade. In: Annales de Biologie Clinique. Vol. 70. pp. 492–495.

Foot, C., Naylor, C., Imison, C., 2010. The quality of gp diagnosis and referral.

Friedberg, M. W., Hussey, P. S., Schneider, E. C., 2010. Primary care: a critical review of the evidence on quality and costs of health care. Health Affairs 29 (5), 766–772.

Fuat, A., Hungin, A. P. S., Murphy, J. J., 2003. Barriers to accurate diagnosis and effective management of heart failure in primary care: qualitative study. Bmj 326 (7382), 196.

Gafni, A., Torrance, G. W., 1984. Risk attitude and time preference in health. Management Science 30 (4), 440–451.

Gelfand, J. M., Weinstein, R., Porter, S. B., Neimann, A. L., Berlin, J. A., Margolis, D. J., 2005. Prevalence and treatment of psoriasis in the united kingdom: a population-based study. Archives of dermatology 141 (12), 1537–1541.

Gerber, Y., Benyamini, Y., Goldbourt, U., Drory, Y., et al., 2010. Neighborhood socioeconomic context and long-term survival after myocardial infarction. Circulation 121 (3), 375–383.

Glaeser, E. L., Laibson, D., Sacerdote, B., 2002. An economic approach to social capital. The Economic Journal 112 (483).

Goldman, D., Smith, J. P., 2011. The increasing value of education to health. Social science & medicine 72 (10), 1728–1737.

Goldman, D. P., Smith, J. P., 2002. Can patient self-management help explain the ses health gradient? Proceedings of the National Academy of Sciences 99 (16), 10929–10934.

Goodwin, F. K., Jamison, K. R., 2007. Manic-depressive illness: bipolar disorders and recurrent depression. Vol. 1. Oxford University Press.

Gordon, R., McDermott, L., Stead, M., Angus, K., 2006. The effectiveness of social marketing interventions for health improvement: what's the evidence? Public health 120 (12), 1133–1139.

Gouyon, M., 2010. Lenquête sur le recours au spécialiste en médecine de ville en 2007. DREES, document de travail, 1–173.

Grossman, M., 1972. On the concept of health capital and the demand for health. Journal of Political economy 80 (2), 223–255.

Hättenschwilera, J., Höcka, P., Luthera, R., Modestina, J., Seifritzb, E., 2009. Bipolar disorder: diagnosis. In: Swiss Medical Forum/Schweizerisches Medizin-Forum 2009; 9 (42): 750. Vol. 754.

Hawe, P., Shiell, A., 2000. Social capital and health promotion: a review. Social science & medicine 51 (6), 871–885.

Hummer, R. A., Lariscy, J. T., 2011. Educational attainment and adult mortality. In: International handbook of adult mortality. Springer, pp. 241–261.

Johnson, G., Smith, G., Dramis, A., Grimer, R., 2008. Delays in referral of soft tissue sarcomas. Sarcoma 2008.

Johnston, D. W., Lordan, G., Shields, M. A., Suziedelyte, A., 2015. Education and health knowledge: Evidence from uk compulsory schooling reform. Social Science & Medicine 127, 92–100.

Jusot, F., Khlat, M., 2013. The role of time and risk preferences in smoking inequalities: a population-based study. Addictive behaviors 38 (5), 2167–2173.

Kahneman, D., Frederick, S., 2002. Representativeness revisited: Attribute substitution in intuitive judgment. Heuristics and biases: The psychology of intuitive judgment 49, 49–81.

Kawachi, I., Subramanian, S. V., Kim, D., 2008. Social capital and health. Social capital and health, 1–26.

Kelly-Irving, M., Delpierre, C., Schieber, A.-C., Lepage, B., Rolland, C., Afrité, A., Pascal, J., Cases, C., Lombrail, P., Lang, T., 2011. Do general practitioners overestimate the health of their patients with lower education? Social science & medicine 73 (9), 1416–1421.

Kenkel, D. S., 1991. Health behavior, health knowledge, and schooling. Journal of Political Economy 99 (2), 287–305.

Lang, T., Ducimetière, P., Arveiler, D., Amouyel, P., Ferrières, J., Ruidavets, J. B., Montaye, M., Haas, B., Bingham, A., 1998. Is hospital care involved in inequalities in coronary heart disease mortality? results from the french whomonica project in men aged 30-64. Journal of Epidemiology & Community Health 52 (10), 665–671.

Lang, T., Lepage, B., Schieber, A.-C., Lamy, S., Kelly-Irving, M., 2011. Social determinants of cardiovascular diseases. Public Health Reviews 33 (2), 601.

Le Fur, P., Yilmaz, E., 2008. Modes d'accès aux spécialistes en 2006 et évolution depuis la réforme de l'assurance maladie: Enquêtes santé protection sociale 2004 et 2006. Questions d'économie de la santé (134), 1–8.

Li, J., Powdthavee, N., 2015. Does more education lead to better health habits? evidence from the school reforms in australia. Social Science & Medicine 127, 83–91.

Llorca, P.-M., Camus, V., Courtet, P., Gourion, D., Lukasiewicz, M., Coulomb, S., 2013. Caractéristiques et modalités de prise en charge des patients présentant un trouble bipolaire en france: enquête montra. L'Encéphale 39 (3), 212–223.

Lupton, D., 1997. Consumerism, reflexivity and the medical encounter. Social science & medicine 45 (3), 373–381.

McDonald, W. I., Compston, A., Edan, G., Goodkin, D., Hartung, H.-P., Lublin, F. D., McFarland, H. F., Paty, D. W., Polman, C. H., Reingold, S. C., et al., 2001. Recommended diagnostic criteria for multiple sclerosis: guidelines from the international panel on the diagnosis of multiple sclerosis. Annals of neurology 50 (1), 121–127.

Murphy, K. M., Topel, R. H., 2006. The value of health and longevity. Journal of political Economy 114 (5), 871–904.

Nutbeam, D., 2008. The evolving concept of health literacy. Social science & medicine 67 (12), 2072–2078.

Nutbeam, D., Kickbusch, I., 2000. Advancing health literacy: a global challenge for the 21st century.

Olsen, K. M., Dahl, S.-Å., 2007. Health differences between european countries. Social science & medicine 64 (8), 1665–1678.

Oreopoulos, P., 2006. Estimating average and local average treatment effects of education when compulsory schooling laws really matter. The American Economic Review 96 (1), 152–175.

Picone, G., Sloan, F., Taylor, D., 2004. Effects of risk and time preference and expected longevity on demand for medical tests. Journal of Risk and Uncertainty 28 (1), 39–53.

Putnam, R. D., 1995. Bowling alone: America's declining social capital. Journal of democracy 6 (1), 65–78.

Putnam, R. D., Helliwell, J. F., 1999. Education and social capital. National Bureau of Economic Research.

Ramos, M., Esteva, M., Cabeza, E., Campillo, C., Llobera, J., Aguiló, A., 2007. Relationship of diagnostic and therapeutic delay with survival in colorectal cancer: a review. European journal of cancer 43 (17), 2467–2478.

Rapp, T., 2014. Patients' diagnosis decisions in alzheimer's disease: the influence of family factors. Social Science & Medicine 118, 9–16.

Richard, M. A., Grob, J. J., Avril, M. F., Delaunay, M., Gouvernet, J., Wolkenstein, P., Souteyrand, P., Dreno, B., Bonefrandi, J., Dalac, S., et al., 2000. Delays in diagnosis and melanoma prognosis (i): the role of patients. International journal of cancer 89 (3), 271–279.

Rocco, L., Fumagalli, E., 2014. The empirics of social capital and health. The Economics of Social Capital and Health: A Conceptual and Empirical Roadmap.

Rocco, L., Fumagalli, E., Suhrcke, M., 2014. From social capital to health–and back. Health economics 23 (5), 586–605.

Scheffler, R. M., Brown, T. T., Rice, J. K., 2007. The role of social capital in reducing non-specific psychological distress: The importance of controlling for omitted variable bias. Social Science & Medicine 65 (4), 842–854.

Smith, S. K., Dixon, A., Trevena, L., Nutbeam, D., McCaffery, K. J., 2009. Exploring patient involvement in healthcare decision making across different education and functional health literacy groups. Social science & medicine 69 (12), 1805–1812.

Talarico, J. M., LaBar, K. S., Rubin, D. C., 2004. Emotional intensity predicts autobiographical memory experience. Memory & cognition 32 (7), 1118–1132.

Van Assche, G., Dignass, A., Reinisch, W., van der Woude, C. J., Sturm, A., De Vos, M., Guslandi, M., Oldenburg, B., Dotan, I., Marteau, P., et al.,

2010. The second european evidence-based consensus on the diagnosis and management of crohn's disease: Special situations. Journal of Crohn's and Colitis 4 (1), 63–101.

Verba, S., Schlozman, K. L., Brady, H. E., 1995. Voice and equality: Civic voluntarism in American politics. Harvard University Press.

Willems, S., De Maesschalck, S., Deveugele, M., Derese, A., De Maeseneer, J., 2005. Socio-economic status of the patient and doctor–patient communication: does it make a difference? Patient education and counseling 56 (2), 139–146.

Wolfe, B. L., Haveman, R. H., et al., 2002. Social and nonmarket benefits from education in an advanced economy. In: Conference series-federal reserve bank of boston. Vol. 47. Federal Reserve Bank of Boston; 1998, pp. 97–131.