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Detection of Alpha-1 Antitrypsin Deficiency by Respiratory Therapists: Experience with an Educational Program

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Abstract

BACKGROUND: Alpha-1 antitrypsin deficiency (AATD) is under-recognized. We hypothesized that respiratory therapists (RTs) could help improve the detection rate of individuals with AATD. The AARC (American Association for Respiratory Care) and Alpha-1 Foundation recently collaborated to create an on-line AATD training program for RTs. This study aimed to determine: (1) the rate of RT enrollment in the training program; (2) the rates of detecting individuals with AATD referred for testing by RTs who took the on-line course ("trained RTs"), and; (3) the genotype distribution of referred individuals found to have AATD.

METHODS: Patients referred by trained RTs submitted blood samples for AATD testing through the existing Alpha-1 Coded Testing (ACT) Study. The AARC sent the first 3 digits of trained RTs' zip codes to the study data center. Investigators there matched those zip codes with those of patients in the ACT study who reported being referred to the study by an RT. The data center determined the number of these patients with AATD and their genotypes. Investigators then aggregated the data and calculated the RT enrollment rate, the rate of detecting individuals with AATD and the distribution of genotype results.

RESULTS: Between 7/1/12 and 6/30/13, 378 RTs took the on-line program (mean 21/month), and 326 patients reported that they were referred for testing by an RT. Thirty four percent (111/326) of these referrals were by trained RTs (6.2/month). Of these 111 referred patients, 62 test blood kits were returned and analyzed (4/month). Two of these specimens (3.2%) were from patients identified as having severe AATD (2 PI*ZZ) and one with PI*SZ (serum level 14 micromolar). Twenty four percent were from PI*MZ heterozygotes.

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CONCLUSIONS: A program to educate RTs about AATD was associated with referral of patients for AATD testing and high rates of detecting individuals with severe deficiency of AAT.

RESPIRATORY CARE Paper in Press. Published on October 08, 2013 as DOI: 10.4187/respcare.02817

Introduction

Alpha-1 antitrypsin deficiency (AATD) is a genetic condition which predisposes to chronic obstructive pulmonary disease and to liver disease (i.e., cirrhosis and hepatocellular carcinoma). AATD is common but under-recognized, with long diagnostic delays between first symptom and initial diagnosis and the frequent need for affected individuals to see multiple healthcare providers before initial recognition (1-6). Recent studies of the diagnostic delay interval over the years 1995 to 2010 indicatethat under-recognition persists despite various strategies to enhance recognition (5-7). Furthermore, current estimates suggest that fewer than 10,000 of the estimated 100,000 Americans with severe AATD have been clinically recognized (1).

The autosomal co-dominant inheritance of AATD exacerbates the problem of under-recognitionbecause family members of affected individuals may also be at risk.Given that specific therapy is available that seems to slow the rate of emphysema progression (1,8-10), strategies to enhance detection are justified and have been proposed (3,7). Optimal recognition of AATD will require enhanced surveillance by all communities of clinicians who see at-risk patients, including pulmonologists, hepatologists, primary care physicians (e.g., family physicians and general internists), nurses, and, given their frequent interaction with COPD patients, perhaps especially respiratory therapists (RTs) (11-13). Indeed, RTs have been shown to effectively participate in the detection of AAT deficient patients (14). In an earlier Alpha-1 Foundation-sponsored multicenter study, RTs were invited to suggest and arrange AATD testing for all patients found to have fixed airflow obstruction in the Pulmonary Function Laboratory. Among the 3,152 patients in this study with fixed airflow obstruction who were tested for AATD, 0.63% were found to be severely AAT deficient (e.g., PI*ZZ, PI*SZ) and approximately

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11% were found to be heterozygotes, thereby establishing that RTs could beeffective participants in a targeted detectionprogram.

To extend these findings and to more fully explore the potential impact of RTs in identifying at-risk individuals, we hypothesized that trained RTs could promote AAT testing and thereby improve detection of affected individuals in the course of their routine practices. Specifically, we reasoned that because:

1. Many patients with COPD see healthcare providers other than pulmonologists (e.g., primary care physicians, nurses, and RTs)
2. RTs have been shown to effectively participate in the diagnosis of patients with AAT deficiency (14), and that
3. RTs can be at the front line of care for such patients, either in the Pulmonary Function Laboratory, in pulmonary rehabilitation, in post-acute settings (e.g., long-term acute care and skilled nursing facilities, homecare), or in ambulatory care settings, where they are in a position to see and recommend testing for at-risk patients,

Respiratory Therapists could help identify previously unrecognized individuals with COPD related to AATD. A recent collaboration between the Alpha-1 Foundation (15) and the AARC (American Association for Respiratory Care) produced an on-line training program called "Emerging Roles of the Respiratory Therapist in Alpha-1 Antitrypsin Deficiency" (16) which provides a curriculum to enhance RTs' knowledge of AATD. Coupled with the availability of free, confidential, at-home testing for AATD through the Alpha-1 Coded Testing Study (ACT [17]), there was an opportunity to assess whether trained RTs referred COPD patients for AAT testing and to determine the yield of RTs' identifying severely AAT deficient individuals. Outcome measures included the number of trained RTs and the rate with which trained RTs

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recommended AATD testing to their patients, as well as the rate with which such tested patients were found to have AATD. The purpose of this study was to assess the effectiveness of this strategy for targeteddetection of individuals with AATD.

Methods

This study was approved by the Institutional Review Board of Cleveland Clinic. Data sharing agreements were developed with other collaborating institutions: The Medical University of South Carolina (MUSC) and the AARC.

The on-line program entitled "Emerging Roles of the Respiratory Therapist in Alpha-1 Antitrypsin Deficiency" consisted of 3 hours of lectures regarding AATD by 3 pulmonologists (including JKS and CS), followed by an opportunity for the participating RT to take an on-line examination. Successful passage of the on-line examination (i.e., $\geq$67% correct) resulted in issuance to the RT of a certificate of competence from the AARC and Alpha-1 Foundation, which were the sponsoring organizations. A nominal fee of $25 for AARC members was assessed to defray administrative expenses.

The ACT Study (17) provides consenting individuals the opportunity to be tested for AATD in a confidential manner at home. Specifically, on-line informed consent to MUSC, the sponsoring institution of the ACT Study, is followed by a demographic questionnaire including zip code. Participants then receive a mailed information form and a coded blood test kit on which a dried blood specimen is collected and sent to the University of Florida Alpha-1 Antitrypsin Genetics Laboratory, which is the testing laboratory (7). Specimens are eluted to determine a serum level of AAT (by nephelometry) and a genotype (by polymerase chain reaction testing for

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the Z and S alleles). A confidential report is then sent to the patient's home with results and an explanation of the results written in lay language.

Respiratory therapists began enrolling in the "Emerging Roles of the Respiratory Therapist in Alpha-1 Antitrypsin Deficiency" on-line program after January 1, 2012 and the study interval was defined a priori to be the one year interval between July 1, 2012 and June 30, 2013. As part of the curriculum of the on-line program, RTs who took the on-line course (hereafter called "trained RTs") were made aware of the ACT Study and invited to refer any patients they deemed likely candidates (i.e., with established COPD) to participate in the ACT Study to learn whether they have AATD.

Under a stipulation of the ACT Study (17), the data analysis required preserving the confidentiality of ACT Study participants, thereby requiring that results of the ACT testing could only be provided to investigators at Cleveland Clinic (JKS and RC) in an aggregated, de-identified format. To do so, a data sharing agreement was required between the three participating institutions: Cleveland Clinic, MUSC,, and the AARC. The AARC housed and co-sponsored the on-line course and sent zip codes of participating RTs to MUSC, where the principal investigator of the ACT Study (CS) works. Reasoning that RTs seeing and referring COPD patients to the ACT Study would reside in the same geographic area, zip codes were used to link the RT recommending AAT testing with the patient who underwent testing. Specifically, when patients seeking ACT testing indicated on the ACT Study information form that they were referred for testing by an RT and when a trained RTs' zip code corresponded with the patient's (i.e., agreement in the first 3 digits of the zip code), that specimen was considered to be one that was referred by a "trained RT." Aggregated, de-identified data about results of ACT Study

RESPIRATORY CARE Paper in Press. Published on October 08, 2013 as DOI: 10.4187/respcare.02817

participants, especially the number of such patients and the AAT genotypes of submitted specimens, were sent to the Cleveland Clinic, where the data were analyzed.

Statistical analysis was conducted using Chi Square. The statistical software was SigmaPlot for Windows Version 11.0 (Systat Software, Inc, 2008). Values of $P < 0.05$ were deemed statistically significant.

Results

As presented in Table 1, 378 RTs completed the on-line program (i.e., were "trained RTs") between July 1, 2012 and June 30, 2013 (mean 21 RTs/month). Three hundred twenty six patients reported that they were referred for AAT testing by an RT. Thirty four percent (111/326) of these referrals were fromtrained RTs (mean 6.2 patients/month).Table 2 shows the results of blood test kit analyses for patients who were referred by trained RTs. Of the 111 referred patients who requested test kits through the ACT Study, blood test kit specimens were submitted by 62 (55.8% at a mean rate of 4 specimens received/month). Among these 62 (Table 3), two (3.2%) were found to have severe AATD, which was defined as having a serum AAT level below the "protective threshold" value of 11 micromolar [1,2]. Both of these patients were PI*ZZ. A third PI*SZ patient had a serum AAT level slightly exceeding the protective threshold (i.e., 14 micromolar). Thirty two percent of patients referred by trained RTs carried at least one abnormal AAT allele; 24.2% were PI*MZ.

Of the 215 patients who requested ACT Study test kits that were referred by RTs who had not participated in the on-line program, blood specimens were submitted by 109 (50.7%). Of these 109, 4 (3.7%) indicated severe deficiency of AAT: 3 individuals were PI*ZZ and 1 was PI*Z Null. A fifth PI*SZ individual was not severely deficient (serum AAT level of 12.2

micromolar). Forty seven percent of patients carried at least one abnormal AAT allele (i.e., anything other than PI*MM); 24.8% were PI*MZ.

Discussion

The main findings of this proof-of concept study are that an on-line program to instruct RTs regarding diagnosis and management of AATD was widely used in the first year of implementation (N = 378 participants), that RTs who took the on-line course did suggest AAT testing to their patients, and that, despite only a small number of submitted specimens over the year of study, the yield of detecting individuals with severe deficiency of AAT was higher (3.2%) than in many previously reported targeted detection studies. Also, the yield of detecting PI*MZ individuals was very high (24.2%).

As a comparison regarding the impact of the on-line course, RTs who did not take the on-line course also referred their COPD patients to the ACT Study over the study interval and the rate of detecting severely AAT deficient individuals was similar to that in the "trained RT" group (3.7%); in this group, the rate of detecting PI*MZ individuals was similarly high (24.8%).

In the context of the hypothesis that persisting under-recognition of AATD can be addressed by novel strategies – e.g., encouraging RTs to advise patients to undergo testing using free, confidential, at-home blood test kits – our findings reinforce the important role that RTs may play in helping to detect patients with AATD. The finding thatthe rates of detecting severely AAT deficient individuals among the "trained RTs" and those RTs who did not take the on-line course were similarly high (3.2% and 3.7%, respectively) suggests that the key element in driving detection of affected individuals was RT involvement in targeted detection rather than course completion. While taking the on-line course likely enhanced RTs' knowledge of AATD,

RESPIRATORY CARE Paper in Press. Published on October 08, 2013 as DOI: 10.4187/respcare.02817

RTs' awareness of the option for their patients to be tested using the ACT Studyalone seemed to account for the high rate of detecting severely deficient individuals in this study.

In demonstrating a novel and efficient strategy for detecting individuals with severe deficiency of AAT, this study extends experience with targeted AATD detection strategies.As previously reviewed (3), many such strategies have been undertaken to date, including:attempts to raise awareness of AATD among primary care physicians and RTs using various instructional methods (e.g., continuing medical education lectures, targeted publications), making free test kits available for use in physician offices as well as confidential in-home testing (17), interest in developing a point-of-care laboratory test for AAT, including written recommendations to test for AATD on the pulmonary function test reports of patients with fixed airflow obstruction on spirometry (18), issuing prompts within the electronic medical record for AAT testing of patients with fixed airflow obstruction (19,20), and reconsidering screening of newborns for AATD (21,22). The prevalence of PI*ZZ individuals detected in 9 prior targeted detection reports has been variable (range 0 –12%), with 6 of the 9 studies reporting rates of PI*ZZ detected individuals less than the 3.2% rate detected by trained RTs in the current study; one of the 9 earlier studies (23) reported an identical rate of 3.2%.

The current study also extends earlier efforts by linking the role of RTs as caregivers who encounter COPD patients in many settings with a strategy by which AAT testing can be done free and confidentially and which does not require a specific physician intervention to perform testing. In this regard, the testing strategy here amplifies the benefits that RTs have conferred in other clinical interventions (e.g., administering respiratory care protocols for liberation from mechanical ventilation or for allocating inpatient respiratory care, etc. [24-26]) and demonstrates

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the potential benefits of having allied health providers function at the "top of their licenses" in the new model of value-based healthcare.

Several limitations of the study merit discussion. First, the requirement to preserve patient anonymity in the ACT Study and the need for shared data agreements to conduct the study required a novel strategy to link the referring "trained RT" to the received specimens by concordant zip codes (rather than actual names or specific identifiers). Hence, misclassification is possible. While it seems highly likely that a referring trained RT was the same RT who recommended testing for a patient whose specimen was submitted from a matching zip code, it is possible that specimens could be misattributed. For example, if the referring, trained RT happened to live in a different state than where he/she was practicing when referring the patient to the ACT Study, the specimen would not be linked to the RT. In this circumstance, the analysis would underestimate the prevalence of testing recommended by trained RTs and the frequency of detecting severely AAT deficient individuals could also be underestimated. Conversely, if a trained RT happened to live in the same state as a patient submitting a specimen but was not the actual RT who saw the patient and recommended AAT testing, the specimen could be mistakenly attributed to the RT, thereby potentially inflating the rates. That said, the latter scenario seems unlikely.

A second limitation is that with only 62 submitted specimens of referred patients over the 1 year study interval, the study size was small, lessening the robustness of the prevalence estimates. That said, the observed rate of detecting 3.2% severely AAT deficient subjects and 32.3% of patients with at least one abnormal AAT allele (including 24.2% PI*MZ individuals) far exceeds the usual observed frequencies in targeted detection studies (7) or the estimated population prevalence rates for these AAT variants.

RESPIRATORY CARE Paper in Press. Published on October 08, 2013 as DOI: 10.4187/respcare.02817

The significance of this study is that it offers support for broader efforts to train RTs to help detect individuals with AATD, thereby potentially helping to address the persisting under-recognition of AATD. Because many patients with COPD are not seen by pulmonologists but may see RTs (e.g., in pulmonary function laboratories or in pulmonary rehabilitation), the strategy of encouraging RTs to recommend testing holds special promise. Of course, replication of these results in a larger series will be important.

In conclusion, this study has shown that a program that informs RTs about AATD was associated with referral of patients for AATD testing and a high rate of detecting individuals with severe deficiency of AAT. To the extent that the rate of detecting severe AAT deficient patients here exceeds that in most prior reports of targeted testing, these findings support the idea that RTs can play important roles in enhancing detection of individuals with AATD and that training RTs is an effective measure to enhance AATD detection.

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RESPIRATORY CARE Paper in Press. Published on October 08, 2013 as DOI: 10.4187/respcare.02817

References

1. Stoller JK (co-chairman), Snider GL, Brantly ML, Fallat RJ, Stockley RA for the Alpha-1 Antitrypsin Deficiency Task Forceof the American Thoracic Society/European Respiratory Society. Standards for the diagnosis and management of patients with alpha-1 antitrypsin deficiency. Am J Respir Crit Care Med 2003;168(7):816-900 and Respir Care 2003;48:1043-1047.
2. Stoller JK, Aboussouan L. Concise clinical review: Alpha-1 antitrypsin deficiency. Am J RespirCrit Care Med 2012;185(3):246-259.
3. Aboussouan LS, Stoller JK. Detection of alpha-1 antitrypsin deficiency: A review. Respir Med 2009;103(3):335-341.
4. Stoller JK, Smith P, Yang P, Spray J. Physical and social impact of alpha-1 antitrypsin deficiency: results of a survey. Cleve Clin J Med1994;61(6):461-467.
5. Stoller JK, Sandhaus RA, Turino G, Dickson R, Rodgers K, Strange C. Delay in diagnosis of alpha-1 antitrypsin deficiency: A continuing problem. Chest 2005;128(4):1989-1994.
6. Campos MA, Wanner A, Zhang G, Sandhaus RA. Trends in the diagnosis of symptomatic patients with alpha-1 antitrypsin deficiency between 1968 and 2003. Chest 2005;128(3):1179-1186.
7. Stoller JK, Brantly M. The challenge of detecting alpha-1 antitrypsin deficiency. J COPD 2013;10 Suppl1:26-34.
8. Dirksen A, Dijkman JH, Madsen F, Stoel B, Hutchison DC, Ulrik CS, et al. A randomized clinical trial of alpha-1 antitrypsin augmentation therapy. Am J Respir Crit Care Med 1999;160(5 pt 1):1468-1472.

9. Dirksen A, Piitulainen E, Parr DG, Deng C, Wencker M, Shaker SB, Stockley RA. Exploring the role of CT densitometry: A randomised study of augmentation therapy in alpha-1 antitrypsin deficiency. Eur Respir J 2009;33(6):1345-1353.

10. Chapman KR, Stockley RA, Dawkins C, Wilkes MM, Navickis RJ. Augmentation therapy for alpha-1 antitrypsin deficiency: A meta-analysis. COPD 2009;6(3):177-184.

11. Stoller JK, Fromer L, Brantly M, Stocks J, Strange C. Primary care diagnosis of alpha-1 antitrypsin deficiency: Issues and opportunities. Cleve Clin J Med 2007;74(12):869-874

12. Stoller JK. Emerging role of the respiratory therapist and the diagnosis of alpha-1 antitrypsin deficiency. AARC Times 2012;36:11-13.

13. Stoller JK. Key current clinical issues in alpha-1 antitrypsin deficiency. Respir Care 2003;48(12):1218-1224.

14. Rahaghi FF, Sandhaus RA, Strange C, Hogarth K, Eden E, Stocks JK, et al. The prevalence of alpha-1 antitrypsin deficiency among patients found to have airflow obstruction. J COPD 2012;9(4):352-358.

15. Walsh JW, Snider GL, Stoller JK. A review of the Alpha-1 Foundation: Formation, impact, and critical success factors. Respir Care 2006;51(5):526-531.

16. American Association for Respiratory Care web site. http://www.aarc.org/education/alpha1_course/. Accessed July 18, 2013

17. Strange C, Dickson R, Carter C, Carpenter MJ. Holladay B. Lundquist R. Brantly ML. Genetic testing for alpha-1 antitrypsin deficiency. Genetics in Medicine 2004; 6(4):204-210.

18. Rahaghi F, Ortega I, Rahaghi N, Zamudio J, Oliveira E, Ramirez J, Smolley L, et al. The impact of including physician alert accompanying pulmonary function (PFT) results on testing for detection of alpha-1 antitrypsin deficiency. J COPD 2009;6(1):26-30.

19. Jain A, McCarthy K, Xu M, Stoller JK. Impact of clinical support system in an electronic health record to enhance detection of alpha-1 antitrypsin deficiency. Chest 2011;140(1):198-204.

20. Campos M, Hagenlocker B, Martinez N, Lupena H, Caceres F, Gallo De Moraes A, et al. Impact of an electronic medical record clinical reminder to improve detection of COPD and alpha-1 antitrypsin deficiency in the Veterans Administration (VA) system [abstract]. Am J Respir Crit Care Med 2011;183:A5356.

21. O'Brien ML, Buist NRM, Murphey WH. Neonatal screening for alpha-1 antitrypsin deficiency. J Pediatrics 1978; 92(6):1006 – 1010.

22. Sveger T. Liver disease in alpha-1 antitrypsin deficiency detected by screening of 200,000 infants. N Engl J Med 1976; 294(24):1316-1321.

23. Brantly ML, Mishra VS, Viranovskaya N, Zienko L, Corcoran V, Leonard S, et al. Statewide targeted screening and detection of AAT deficiency. Am J Respir Crit Care Med 2003;167:A222

24. Stoller JK, Mascha EJ, Kester L, Haney D. Randomized trial of physician- vs. respiratory therapy consult-directed respiratory care. Am J Respir Crit Care Med 1998; 158(4):1068-1075.

25. Kollef MH, Shapiro SD, Silver P, St. John RE, Prentice D, Sauer S et al. A randomized, controlled trial of protocol- directed versus physician-directed weaning from mechanical ventilation. Crit Care Med 1997;25(4):567-574.

26. Kollef MH, Shapiro SD, Clinkscale D, Cracchiolo L, Clayton D, Wilner R et al. The effect of respiratory therapist-initiated treatment protocols on patient outcomes and resource utilization. Chest 2000;117(2):467-475

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Table 1. Results of the On-Line Course Training

	2012			2013			Rate
	Q1 & Q2	Q3	Q4	Q1	Q2	Total	# / month
RTs trained	271	32	12	35	28	**378**	**21.0**
Patients completing testing	1204	552	408	705	735	**3604**	**200.2**
Patients referred by RT	117	45	36	60	68	**326**	**18.1**
Patients referred by TRAINED RT*	22	20	8	32	29	**111**	**6.2**

**zip code of patient matches zip code of RT supplied by AARC*

RESPIRATORY CARE Paper in Press. Published on October 08, 2013 as DOI: 10.4187/respcare.02817

Table 2. Results of Blood Test Kit Analyses for Patients Who Were Referred by Trained RTs

	2012			2013			Rate
GENOTYPE	Q1 & Q2	Q3	Q4	Q1	Q2	Total	# / month
PI*MM	11	9	4	8	10	67.7%	2.3
PI*MS	1	0	0	0	0	1.6%	0.2
PI*MZ	5	0	0	6	4	24.2%	1.3
PI*MNull	0	0	0	0	0	0.0%	0.0
PI*SS	0	1	0	0	0	1.6%	0.2
PI*SZ	0	0	0	1	0	1.6%	0.2
PI*ZZ	1	0	0	1	0	3.2%	0.2
Total per Quarter	18	10	4	16	14	100%	
Total All	62						

RESPIRATORY CARE Paper in Press. Published on October 08, 2013 as DOI: 10.4187/respcare.02817

Table 3. Activity and Results of Alpha-1 Antitrypsin Deficiency Testing in the "Trained RT" Group vs. Those RTs Who Did Not Take the On-Line Course.

	RT On-Line Course Status		
	Trained	**Untrained**	**P value**
Patients Referred	111	215	N/A
Patients Not Referred	215	N/A	
% Referred	**34.0**		
Total Referred	326		
Specimens Received	62	109	0.695
Patients Referred	111	215	
% Specimens Received	**55.9**	**50.7**	
Total Specimens Received	171		
Severe Deficiency of AAT	2	4	0.775
Specimens Received	62	109	
% Severe Deficiency of AAT	**3.2**	**3.7**	
Patients with ≥ 1 Abnormal AAT Allele*	20	52	0.259
Patients with 0 Abnormal AAT Alleles	62	109	
% Abnormal AAT Allele	**32.3**	**47.7**	
Patients with PI*MZ Genotype	15	27	0.910
Patients without PI*MZ Genotype	62	109	
% PI*MZ Genotype	**24.2**	**24.8**	

**Included alleles: S, Z, Null*
N/A data not available