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Symptom Clusters in Acute Myocardial Infarction: A Secondary Data Analysis

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Short Title: AMI Symptom Clusters

Abstract

Background: Early recognition of acute myocardial infarction (AMI) symptoms and reduced time to treatment may reduce morbidity and mortality. People experiencing AMI experience a constellation of symptoms, but the common constellations or clusters of symptoms have yet to be identified.

Objectives: The objective of this study was to identify clusters of symptoms that represent AMI.

Method: This was a secondary data analysis of nine descriptive, cross-sectional, studies that included data from 1,073 AMI subjects in the United States and England. Data were analyzed using latent class cluster analysis.

Results: Five distinct clusters of symptoms were identified. Age, race, and gender were statistically significant in predicting cluster membership. None of the symptom clusters described in this analysis included all of the symptoms that are considered typical. In one cluster, subjects had only a moderate to low probability of experiencing any of the symptoms analyzed.

Discussion: Symptoms of AMI occur in clusters, and these clusters vary among persons. None of the clusters identified in this study included all of the symptoms that are typically included as symptoms of AMI (chest discomfort, diaphoresis, shortness of breath, nausea, and lightheadedness). AMI symptom clusters must be clearly communicated to the lay public in a way that will assist them in assessing their symptoms more efficiently and will guide their treatment-seeking behavior. Symptom clusters for AMI must also be communicated to the professional community in a way that will facilitate assessment and rapid intervention for AMI.

Key Words: Acuter Myocardial Infarction, Symptoms

Acute Myocardial Infarction Symptom Clusters

Approximately one third of the 1.5 million Americans who have an acute myocardial infarction (AMI) each year will die from their cardiovascular disease (American Heart Association). Unfortunately, most of these deaths occur before patients seek medical treatment (Smith, 1999). It is postulated that early recognition of AMI symptoms and reduced time to treatment will reduce morbidity and mortality (Smith, 1999). How to affect the patients' ability to recognize AMI symptoms, however, has been elusive.

Background

The American Heart Association and the National Heart, Lung, and Blood Institute describe typical AMI symptoms as central chest discomfort that may be described as pressure, squeezing, fullness, or pain. It may radiate to the arms, back, neck, jaw, or abdomen and may include shortness of breath, diaphoresis, nausea, and lightheadedness (American Heart Association, ; National Heart Lung and Blood Institute, 2005). While the symptoms that are associated with AMI have been examined, investigators have neglected to identify specific clusters of symptoms or to relate symptom clusters to racial or ethnic groups.

In many reported studies of cardiovascular disease and other illnesses, it is common to list typical symptoms and have persons rank these symptoms in order of priority, importance, or presence. This method is sequential and tends to orient individuals to think of their symptoms individually, as if the symptoms occurred in isolation. In fact, previous symptom research indicates that persons identify, evaluate, make decisions, and report their symptoms based on clusters or groups of symptoms (Baumann, Cameron, Zimmers, & Leventhal, 1989; Bishop, 1987, 1991; Bishop & Converse, 1986; Leventhal & Diefenbach, 1991). The cognitive process that an individual uses to evaluate symptoms as "clusters" or groups focuses on one symptom as

a starting point and searches for other symptoms that accompany it to validate that the symptom represents an illness (Baumann et al., 1989; Bishop, 1987; Leventhal & Diefenbach, 1991)

In addition, many health-related texts and educational materials for the lay public focus on chest pain as the primary symptom of AMI by generally listing chest pain first and discussing it in the greatest depth. This implies that chest pain is the main, most important, most prevalent, or only symptom of AMI. While it is true that chest pain is the most prevalent symptom of AMI, knowledge of chest pain alone is insufficient to accurately and efficiently identify AMI. Researchers have concluded that the general public is knowledgeable about the association of chest pain with AMI (Caldwell & Miaskowski, 2000; Goff et al., 1998; Johnson & King, 1995; Zerwic, 1998) but lacks awareness of accompanying or alternate symptoms (Caldwell & Miaskowski, 2000; Dempsey & et al., 1995; Finnegan et al., 2000; Goff et al., 1998; Horne, James, Petrie, Weinman, & Vincent, 2000; Johnson & King, 1995; Zerwic, 1998) and the nuances of intensity. They appear to expect symptoms that are sudden and severe, as portrayed in the popular media, termed the "Hollywood heart attack" (Finnegan et al., 2000; Ruston, Clayton, & Calnan, 1998). However, AMI presentations without chest pain are common. Recent observational studies have shown that as many as 33% of all persons diagnosed with AMI did not experience chest pain on admission to the hospital (Canto et al., 2000a; Horne et al., 2000). As a result, the dependence on chest pain as the sole sign of AMI can have devastating consequences.

It has been reported that as many as 87% of persons have more than one symptom of AMI (Richards, Funk, & Milner, 2000) and that, overall, persons experience a mean of 4.75 symptoms as part of their AMI (Horne et al., 2000). Leslie et al. (20) noted that chest pain was the sole AMI symptom in only 35% of the cases that they studied and that, in 57% of the cases,

chest pain was accompanied by other symptoms. Therefore, an important limitation of the previous research on AMI symptoms is that the methods used have been unable to identify and describe the multidimensional symptom experience.

In a study of persons who had previously experienced AMI and their significant others, Q methodology was utilized to determine if persons were able to identify symptoms in clusters and to identify what clusters of symptoms would be expected related to AMI (Ryan & Zerwic, 2004). The researchers found that those who had experience with AMI symptoms clearly expected a cluster of symptoms and were easily able to identify symptoms that they perceived would occur together. This study identified four different symptom clusters associated with AMI.

Previous studies aimed at identifying AMI symptoms have further indicated that AMI symptoms may be specific to demographic groups. However, these common constellations or clusters of symptoms for different demographic groups have yet to be identified because (a) research techniques using small group sampling theory are unable to capture the multidimensional concept of symptom clusters, (b) previous studies have utilized questionnaires that require individuals to consider individual symptoms, or (c) the responses to the questionnaires have been analyzed individually. AMI symptom clusters must be identified and clearly communicated to the lay public in a way that will assist them in assessing their symptoms more efficiently and will guide their treatment-seeking behavior. Symptom clusters for AMI must also be communicated to the professional community in a way that will facilitate assessment and rapid intervention for AMI.

<center>Objective</center>

The objective of this study was to identify clusters of symptoms that represent AMI and to relate the clusters to specific demographic groups.

Methods

Design

This is a secondary data analysis of nine descriptive, cross-sectional studies that included AMI symptoms.

Sample

A thorough examination of the literature related to AMI symptoms, delay, and other relevant topics was performed, and every author was contacted who had published a manuscript that suggested that symptom data were included. Those researchers who had data that met the study criteria were invited to participate. Ten researchers were contacted. One researcher declined participation, and a reply was never received from another in a non-English speaking country.

Data for this study were obtained on 1,073 participants from eight different researchers in the United States ($N = 985$) and England ($N = 88$) who had originally collected data for purposes other than cluster analysis. The primary focus of six of the original data sets was to identify factors that influence delay in seeking treatment in AMI patients. Two studies focused on gender differences in ACS symptoms.

Eligibility requirements for inclusion in the secondary data analysis were: (a) minimum of 50 persons in the data set; (b) subjects experienced AMI validated by serum cardiac markers and EKG changes; (c) data were collected utilizing face-to-face interviews during hospitalization for AMI; (d) symptoms assessed were chest discomfort, shoulder or arm discomfort, back discomfort, abdominal discomfort, neck or jaw discomfort, nausea, vomiting, shortness of breath, sweating, dizziness, weakness, palpitations, and fatigue; (e) demographic data were available (age, race, gender, educational level, and income); (f) documentation of human subjects

protection was available; and (g) subjects were 21 years of age or older. Data sets were de-identified in accordance with HIPAA by the original researcher before being forwarded for secondary analysis. Demographic details of the sample are summarized in Table 1.

Data Analysis

The eight data sets included in this secondary analysis were obtained using different measurement instruments; therefore, the codebooks for all data sets were examined for similarities, and a master database was developed. Data with identical or very similar variable definitions were merged into one variable (e.g., chest pain, chest discomfort). Variables with small numbers of responses that had similar meaning (e.g., dizziness, lightheadedness) or that frequently happen together (e.g., nausea, vomiting) were collapsed into one combined variable. Several variables that were assessed by individual researchers had small numbers of responses when the master database was constructed, and these variables were not included in this analysis. The resulting 12 symptom variables each had at least 746 responses (Table 2).

Latent class cluster analysis for categorical and continuous variables utilizing Latent Gold v.3.0 (Vermunt & Magidson, 2000) was used. Latent class analysis permits empirical exploration between a set of categorical or nominal variables and hypothesizes that the distribution of the responses for *n* items can be explained by a small number of mutually exclusive, discrete subject "classes" or clusters (McCutcheon, 1987). Utilizing latent class analysis, clusters of AMI symptoms are defined by groups of patients who experienced similar clusters or combinations of symptoms. In addition, the percentage of patients experiencing each cluster of symptoms and the conditional probabilities can be calculated. Conditional probabilities are the cluster-specific response probabilities (Carlson, Wang, Falck, & Siegal, 2005) or the probability of a specific symptom being present in the cluster (Vermunt &

Magidson, 2000). For the purposes of this study, conditional probabilities of 70%-100% were considered to be a high probability of experiencing that symptom. Moderate probability of experiencing the symptom was defined as 40%–69%, and low probability of experiencing the symptom was defined as < 40%.

The resulting 12 symptoms in the master database were used as variables (which would define the symptom clusters), and demographic characteristics (age, gender, and race) of the respondents were used as covariates. The hypothesized covariates served as exogenous variables that describe or predict (rather than define or measure) the symptom cluster (Vermunt & Magidson, 2000).

In latent class analysis, a one-class model would imply that there was no relationship between the symptoms and that all subjects have the same probability of experiencing an identical cluster of AMI symptoms (Aldenderfer & Blashfield, 1984). Because *this* is clinically unlikely, this solution was not pursued. Two-, 3-, 4-, 5-, and 6-class models were developed while assessing the improvement of fit statistics: Log Likelihood (LL); Bayesian Information Criterion (BIC LL), which is an alternative approach to assessing model fit; Akaike Information Criterion (AIC LL); and the Model Fit likelihood ratio chi-squared statistic L^2 (indicating the degree of association among the variables that still remains unexplained after estimating the model and the size of each class or group). L^2 is the preferred fit statistic because it allows the researcher to later calculate the conditional probabilities; however, all of the statistics are used to identify the best model fit (McCutcheon, 1987). As the model fit improves, the absolute values of the fit statistics decline (Table 3). In this study, the BIC (LL) began to rise between a 4-cluster and 5-cluster model while LL, AIC (LL), and L^2 continued to decline. The decrease in these fit statistics was minimal (< 2% change in each); however, the difference in the L^2

remained statistically significant between the 4- and 5-cluster models ($p < .000$). A 5-class model was determined to be the best model fit based on assessment of the 4 fit statistics and was determined to be the most clinically relevant solution. The decision to pursue the 5-cluster model was further confirmed utilizing the Wald statistic, which assesses the statistical significance of the set of parameter estimates that is associated with any given variable (Wald = 140.31, $p < 0.001$).

After the 5-cluster model of symptoms was determined, chi-square statistics were used to examine the relationship between cluster membership and the covariates of age, gender, and race. Chi-square statistics were also used to determine if there was a relationship between intensity of discomfort and the location of the AMI and the demographic characteristics of the cluster members. Analysis of Variance (ANOVA) was used to determine if there were differences in the mean intensity of discomfort scores for the overall sample related to their demographic characteristics.

Results

Five distinct clusters of symptoms were identified utilizing Latent Gold cluster analysis techniques (Figure 1). The number of individuals in each cluster, their demographic characteristics, and the conditional probabilities of each symptom being included in that cluster are detailed in Table 4.

Members of Cluster 1 had a high probability of experiencing chest discomfort, shoulder/arm/hand pain, and weakness. They had a moderate probability of experiencing nausea/vomiting, shortness of breath, dizziness/lightheadedness, and fatigue, and a low probability of experiencing neck/jaw pain, back pain, abdominal pain, or indigestion. Four hundred sixty-two (43%) persons experienced cluster 1 symptoms. Mean age was 63.4 years of

age, and participants were evenly distributed between men (*n* = 256, 55.4%), and women (*n* = 206, 44.6%).

Members of cluster 2 had a high probability of experiencing chest discomfort and shoulder/arm/hand pain and a moderate probability of experiencing sweating. The probability of experiencing other symptoms (neck/jaw pain, back pain, abdominal pain, indigestion, nausea/vomiting, shortness of breath, dizziness/lightheadedness, weakness, and fatigue) was low. Twenty-three percent of persons in the sample (*n* = 253) experienced symptoms consistent with cluster 2. Mean age in this cluster was 62.9 years of age, and participants were predominately male (*n* = 165, 65.2%).

Members of Cluster 3 were likely to experience the most symptoms. They had a high probability of experiencing chest discomfort, shoulder/arm/hand pain, nausea/vomiting, shortness of breath, sweating, dizziness/lightheadedness, weakness, and fatigue. They had a moderate probability of experiencing neck/jaw pain, back pain, or indigestion and a low probability of experiencing abdominal pain. Members of this cluster also experienced more intense pain, with 86% of the members reporting pain intensity > 5 on a ten-point scale. Sixty-two percent of members of cluster 3 were less than 65 years of age, with a mean age of 60.2 years. Members of cluster 3 were the youngest and had the highest proportion of minority members (28.8% versus $\leq$ 20% for all other clusters). They were fairly evenly split between men (*n* = 108, 58.4%) and women (*n* = 77, 41.6%). One hundred eighty-six (17%) persons experienced cluster 3 symptoms.

Members of cluster 4 had a high probability of experiencing shoulder/arm/hand pain along with GI symptoms (abdominal pain and indigestion). They had a moderate probability of experiencing chest discomfort and shortness of breath and a low probability of experiencing

neck/jaw pain, back pain, nausea/vomiting, sweating, dizziness/lightheadedness, weakness, and

fatigue. Ninety-five persons (8%) experienced cluster 4 symptoms. Their mean age was 62.4

years of age, and they were primarily male (71.6%, $n = 68$).

Members of cluster 5 did not have a high probability of experiencing any single

symptom. They had a moderate probability of experiencing chest discomfort and shortness of

breath and a low probability of experiencing all other symptoms. The probability of

experiencing neck or jaw pain, back pain, abdominal pain or indigestion, nausea/vomiting, or

sweating was less than 15%. There was no difference between the number of men ($n = 35$,

46.7%) and women ($n = 40$, 53.3%). Interestingly, this was the smallest group ($n = 75$, 6%), and

it was also the oldest group (mean age 67.38 years).

While symptoms were used to define the clusters, covariates were used to describe or

predict cluster membership (Vermunt & Magidson, 2000). In this study, age ($p < .001$), gender

($p = .047$), and race ($p = .027$) were individually significant predictors of cluster membership at

the $p < .05$ level utilizing latent cluster analysis. To further validate the importance of the

covariates, chi-square statistics were used to examine the characteristics of persons who

experienced each cluster of symptoms. Age less than 65 years or 65 years or greater (χ^2 13.624,

df 4, $p = .009$), gender (χ^2 17.798, df 4, $p = .001$), and race (χ^2 14.86, df 4, $p = .005$) were all

significantly related to cluster membership.

Because the model only considered the presence or absence of symptoms though

intensity of discomfort may influence recognition of symptoms, chi-square statistics were also

used to examine the relationship between intensity of discomfort and characteristics of the

cluster members. Intensity of discomfort was recoded when necessary to conform to a 1–10

scale. Age < 65 years or ≥ 65 years (χ^2 20.586, *df* 10, $n = 747$, $p = .024$), gender (χ^2 23.511, df

10, $n = 751$, $p = .009$), and race (χ^2 88.860, df 40, $n = 727$, $p < .000$) were all significantly related to intensity of discomfort. The mean discomfort intensity scores for persons < 65 years of age were significantly different than the mean scores for persons $\geq$ 65 years of age ($F = 7.705$, df 1, $p = .006$). Seventy percent of the study participants younger than 65 years of age experienced discomfort that was severe (7 or greater on a 0–10 scale), as opposed to 59% of persons $\geq$ 65 years of age. Women reported more intense discomfort ($F = 44.489$, df 1, $p \leq .000$), with 62% of females reporting pain at $\geq$ 8 and 50% of men reporting pain $\geq$ 8. Twenty-nine percent ($n = 175$) of White respondents reported pain intensity at 5 or less, while 13% of Blacks and 16% of Hispanics reported less intense discomfort (5 or less) ($F = 11.284$, df 1, $p = .001$). The location of the infarct was not significantly associated with cluster membership or with intensity of discomfort.

Discussion

Chest pain or discomfort was not universally present in this sample of AMI patients, and 177 (16.6%) reported that they experienced no chest symptoms. This finding is consistent with recent observational studies that have reported that as many as 33% of all persons with AMI experience no chest pain (Canto et al., 2000a; Horne et al., 2000). Subjects in our study who did not experience chest pain were evenly distributed between men (52%) and women (48%); however, 61% of those who did experience chest discomfort were men, and 39% were female. This is consistent with the literature (Canto et al., 2000a; Goldberg et al., 1998). In addition, women who did experience chest discomfort experienced more intense discomfort than men. This finding has not been previously reported in the literature.

The presence of chest pain in subjects in our study may, however, be misleading because all types of chest symptoms (mild, moderate, severe, right, left, and substernal) were grouped

into one variable. The fact that intensity of discomfort had a statistically significant influence on cluster membership and was related to age, race, and gender needs to be explored further. Still, the fact that chest pain was not the most likely symptom in 2 of the 5 clusters is an important finding. This finding may be particularly problematic since clinicians in triage may fail to ascribe a cardiac diagnosis, perform a comprehensive risk analysis, order appropriate diagnostic testing, and administer prompt treatment because they rely on chest symptoms as a classic sign of AMI. As a result, the dependence on chest pain as the primary sign of AMI can have devastating consequences.

None of the symptom clusters described in this analysis included all of the symptoms that are considered typical of AMI. Jaw pain, which is considered a typical symptom, was experienced in our study with moderate frequency in only one group (cluster 3, 52%) and with low frequency in all of the other groups. Back pain, another symptom on the list of typical symptoms, occurred with moderate frequency (43%) in members of cluster 3 and with low frequency in all other clusters. Fatigue, which is considered to be an atypical symptom, was prominent in Cluster 1 in the high probability category (91%) and occurred with moderate frequency in cluster 2 (60%). Weakness, also considered to be an atypical symptom, was prominent in clusters 1 and 3 (95% and 84%, respectively).

These findings are consistent with the literature that shows that, while women experience more back pain, jaw pain, shortness of breath, nausea and vomiting, and fatigue, men are more likely to experience sweating (Ashton, 1999; Culic, Eterovic, Miric, & Silic, 2002; DeVon & Zerwic, 2003; R. Goldberg et al., 2000; R. J. Goldberg et al., 1998; Meshack & et al., 1998; Milner, Funk, Richards, Vaccarino, & Krumholz, 2001; Penque & et al., 1998; Zucker & et al., 1997). Clusters 2 and 4 had the highest percentage of male members (65% and 72%,

respectively), and subjects in these clusters had lower probabilities of experiencing neck/jaw pain, back pain, nausea/vomiting, shortness of breath, and fatigue. However, the findings in cluster 4 are not consistent with previous studies that indicate that men have more chest pain.

The finding that participants in cluster 5, who were the oldest, did not have a high probability for any symptom is consistent with the findings of previous studies. Prior findings indicate that, with aging, the spectrum of symptoms experienced with AMI changes significantly and may compound the problem of symptom recognition for older adults. Recent studies have shown that older persons are more likely to experience atypical AMI symptoms (Bayer, Chadha, Farag, & Pathy, 1986; Canto et al., 2000a; Culic et al., 2002; R. Goldberg et al., 2000; Maheshwari, Laird-Fick, Cannon, & DeHart, 2000; Meshack & et al., 1998; Milner et al., 2001; Paul et al., 1996). With aging, there is less incidence of arm pain, sweating, chest pain, and nausea and vomiting, but more syncope, confusion, and dyspnea (Bayer et al., 1986; Canto et al., 2000a; Culic et al., 2002; R. Goldberg et al., 2000; Maheshwari et al., 2000). In contrast, the mean age for cluster 3 was 60.23 years (the cluster with the youngest members), and these persons had the most symptoms in the high probability category and experienced the most discomfort.

Cluster 4 had a high probability of indigestion and abdominal pain. These symptoms may confuse people and may lead to incorrect attribution of symptoms to a gastrointestinal cause. This finding may be more worrisome for those with diabetes who may have chronic gastroparesis and are at high risk for AMI (Vinik, Maser, Mitchell, & Freeman, 2003).

The findings that age, race, and gender are statistically significant in predicting cluster membership are important and need to be explored further. Identification of the cluster of symptoms that are most predictive of AMI in subgroups of the population may help to increase

the appropriate identification of AMI and decrease the number of unnecessary cardiac work-ups that are done in hospital emergency departments.

The major strengths of this study are the large data set and the innovative data analyses. No prior investigators have identified symptom clusters in AMI or the possible implications of this knowledge for the lay public, those at risk for first time AMI or repeat infarction, and for health care providers. This study included a wide variety of socioeconomic and geographic groups from the U.S. and England and thus may be generalized to the larger population. The resulting large sample of subjects and comprehensive number of symptoms assessed contributes to our understanding of the AMI symptom experience. The methodology of in-depth interview adds to the reliability and validity of the data. While only small numbers of minority subjects (17%) were included in the sample, this number is only slightly less than the U.S. population, of which approximately 25% are classified as minority (U.S. Census Bureau, 2000). Replication of this study in specific minority populations may be useful.

Limitations include lack of control over variables and data collection procedures because secondary data analysis techniques were employed. Each primary investigator defined their symptom variables, and therefore the analysis was limited to the available data. There were also cases of missing variables. Multiple definitions of the type and intensity of chest discomfort were used in the primary data collection. Collapsing all descriptions of chest discomfort may result in the loss of some descriptors of the symptoms of AMI. Further analysis of chest discomfort descriptors and intensity may reveal different findings.

Conclusion

The symptoms of AMI do not occur in isolation. Unfortunately, the designs of previous studies have not included the identification of clusters of symptoms that represent AMI. This

study demonstrates that different clusters of symptoms exist and that these clusters differ by racial and demographic group. Knowledge of the clusters of symptoms that occur can be useful to patients in recognizing symptoms and promptly seeking care and of value to the clinician in assessing the clinical presentation of persons with symptoms that may be consistent with AMI and facilitating more rapid and accurate triage.

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Table 1

Sample Characteristics

Variables			N	%
Age	N = 1,062	Mean ± SD	62.9 ± 12.9	
		Median	64.0	
		Range 20 - 40	48	4.5
		41 - 60	388	36.6
		61 - 70	284	26.7
		71 - 97	342	32.2
Gender	N = 1,069	Female	437	40.9
		Male	632	59.1
Race	N = 1,043	White	870	83.4
		Black	113	10.8
		Hispanic	22	2.1
		Asian/Pacific	15	1.4
		Others	23	2.2
Marital Status	N = 822	Married	530	64.5
		Widowed	139	16.5
		Divorced/Separated	91	11.0
		Never married	58	8.0
Education	N = 986	≤ High school	642	65.1
		> High school	344	34.9

% do not equal 100% due to missing data

Table 2

Frequency of AMI symptoms

| | | Yes | |
Symptoms	Total N	N	%
Pain or discomfort anywhere in the chest	1069	892	83.4
Pain or discomfort in shoulder or arm or hand	746	454	60.9
Pain or discomfort in the neck or jaw	978	321	32.8
Sweating	1062	603	56.8
General weakness	922	482	52.3
Shortness of breath	1061	551	51.9
Fatigue	975	478	49.0
Nausea or vomiting	1067	483	45.3
Dizziness or lightheadedness	1067	414	38.8
Indigestion	848	297	35.0
Pain or discomfort in the back	976	287	29.4
Pain or discomfort in the abdomen	978	200	20.4

Table 3

Model clusters and Diagnostic Indices

Model	LL	L^2	BIC(LL)	AIC(LL)	df
1 Cluster	-7756.7457	3317.334	15598.082	15537.49	18846
2 Cluster	-7416.2901	2636.423	15008.811	14882.58	18833
3 Cluster	-7292.7770	2389.396	14853.425	14661.55	18820
4 Cluster	-7239.0681	2281.978	14837.648	14580.14	18807
5 Cluster	-7204.0265	2221.064	14859.205	14536.05	18794
6 Cluster	-7178.8863	2161.615	14900.56	14533.77	18781

Table 4

Conditional Probabilities

	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
N	462	253	186	95	75
% of total	43%	23%	17%	8%	6%
Mean Age	63.42	62.89	60.23	62.37	67.38
Gender Male	55.4%	65.5	58.4	71.6	46.7
Race					
White	83.3%	83.4%	71.3%	84.2%	80.0%
Black	9.7%	7.9%	17.6%	6.3%	12.0%
Other	6.9%	8.7%	11.2%	9.5%	8.0%
Conditional Probabilities					
Chest Pain	88.02%	82.93%	95.94%	69.46%	48.38%
Shoulder/Arm/Hand Pain	73.91%	75.75%	81.50%	82.52%	30.04%
Neck/Jaw Pain	34.47%	32.40%	52.26%	19.89%	0.22%
Back Pain	34.85%	26.08%	42.58%	16.21%	0.16%
Abdominal Pain	7.76%	0.16%	38.93%	99.08%	8.51%
Indigestion	11.40%	8.13%	63.42%	97.48%	10.54
Nausea/Vomiting	45.25%	27.07%	88.87%	29.94%	13.50%
Shortness of breath	52.39%	24.64%	80.79%	44.22%	64.42
Sweating	64.11%	42.50%	87.00%	36.31%	12.21%

Dizziness/ Lightheadedness	44.82%	10.85%	77.73%	13.18%	21.35%
Weakness	84.03%	1.24%	95.02%	6.67%	30.43%
Fatigue	60.12	13.88%	91.06%	24.58%	31.85%

Figure 1

Latent Cluster Analysis Output
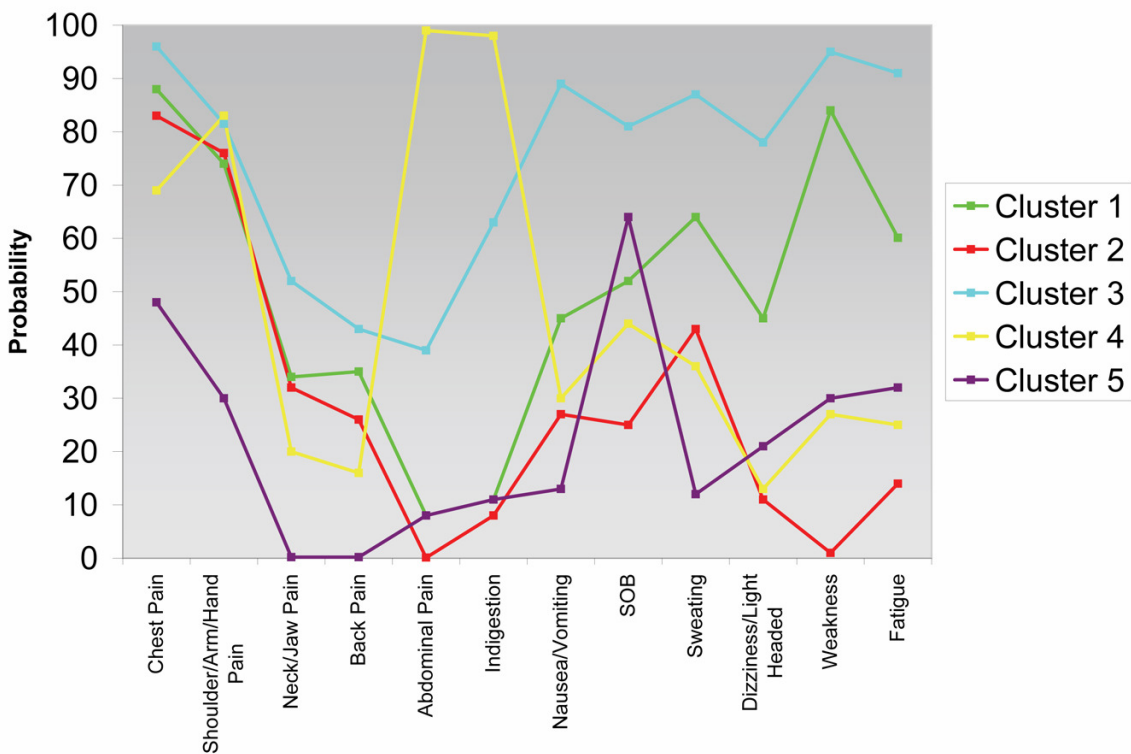
The 12 symptoms that were included in the analysis are shown on the X axis.

Conditional probabilities of these symptoms occurring are shown on the Y axis.