Does *Vibrio vulnificus* present a health threat to Canadians?

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S Stavric, B Buchanan. Does *Vibrio vulnificus* present a health threat to Canadians? Can J Infect Dis 1997;8(5):279-285.

OBJECTIVE: To review recent data on *Vibrio vulnificus* and its properties, characteristics of disease and epidemiology, sources of infection, population at risk, infectious dose, documented cases of infection and health risk from *V vulnificus* infection in Canada.
DATA SOURCE: A MEDLINE and CURRENT CONTENTS search (1981 through September 1996) using the main heading 'Vibrio vulnificus', 'Vibrio species', 'seafood', etc. Relevant articles were also selected from the literature collection in the authors' laboratory.
STUDY SELECTION AND DATA EXTRACTION: The authors judged articles relevant to the objective of the paper and selected them for a review.
DATA SYNTHESIS: *V vulnificus*, an important cause of septicemia, wound infections and gastroenteritis, is considered to be one of the most invasive and rapidly lethal human pathogens. Molluscan shellfish concentrate this organism from warm seawater and present the greatest danger to consumers. Infections with this pathogen have been reported throughout the world. Most deaths have resulted from the consumption of raw or undercooked oysters, fewer from contact with seawater. Individuals with underlying disease, particularly those with liver diseases and iron overload, are the most susceptible.
CONCLUSION: The two reported cases of *V vulnificus* wound infection in Canada might not represent the real situation. Infection with this organism may go unrecognized, unreported or simply may not occur. Medical professionals need to become aware of this pathogen and the dire consequences of infection in individuals with underlying disease.

Key Words: *Oysters, Septicemia,* Vibrio vulnificus*, Wound infections*

Vibrio vulnificus représente-t-il un danger pour la santé des Canadiens?

OBJECTIF : Passer en revue les résultats récents sur *Vibrio vulnificus* et ses propriétés, les caractéristiques de la maladie et son épidémiologie, les sources d'infection, la population à risque, la dose infectieuse, les cas documentés d'infection et le risque sanitaire associé à l'infection à *V. vulnificus* au Canada.
SOURCE DES DONNÉES : Une interrogation du réseau MEDLINE et des TABLES DES MATIÈRES COURANTES (1981 à septembre 1996) à partir des mots clés «*Vibrio vulnificus*», «*Vibrio species*» et «*seafood*» etc. Les articles pertinents ont également été sélectionnés à partir de la collection de documents du laboratoire des auteurs.
SÉLECTION DES ÉTUDES ET EXTRACTION DES DONNÉES : Les auteurs ont sélectionné les articles pertinents pour l'article et les ont choisis en vue d'une synthèse.
SYNTHÈSE DES DONNÉES : *V. vulnificus* est une importante cause de septicémie, d'infection des plaies et de gastro-entérite. On le considère comme l'un des organismes pathogènes les plus invasifs et les plus rapidement mortels pour l'être humain. Les mollusques et les fruits de mer concentrent cet organisme à partir d'eau de mer chaude et représentent un danger considérable pour ceux qui les consomment. Les infections occasionnées par cet organisme pathogène ont été signalées partout dans le monde. La plupart des décès ont découlé de la consommation d'huîtres crues ou trop peu cuites et, dans une proportion moindre, du contact avec de l'eau de mer. Les sujets souffrant de maladies sous-jacentes, par

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exemple de maladies hépatiques et de surcharge ferrique, sont les plus à risque.
CONCLUSION : Les deux cas d'infection de plaies à *V. vulnificus* au Canada ne seraient pas représentatifs de la situation réelle. L'infection causée par cet organisme peut passer inaperçue, n'être pas signalée ou être simplement absente. Les professionnels de la santé doivent se sensibiliser à l'existence de cet organisme pathogène et des conséquences funestes de l'infection chez les sujets qui souffrent de maladies sous-jacentes.

Vibrio vulnificus is considered one of the most invasive and rapidly lethal human pathogens (1). It causes sporadic cases of primary septicemia, gastroenteritis and severe wound infection. Persons who have pre-existing illness, especially those with liver dysfunction, are at the greatest risk of infection. In these individuals, the mortality rate despite treatment exceeds 50%; without treatment, the mortality rate can be 100% (2). Most cases in North America have occurred in the southeastern United States where this organism has emerged as a leading cause of deaths associated with consumption of seafood.

The organism is acquired mainly through the consumption of raw or undercooked molluscan shellfish, but it can also enter through skin lesions following exposure to seawater (eg, handling shellfish, bathing). It occurs naturally in warm waters, and its presence is not associated with fecal contamination. Because known shellfish control measures do not prevent or eliminate *V vulnificus* from shellfish (3), this organism's presence is generating much concern in the shellfish and food services industries, in regulatory agencies and among health officials. Currently, education of the public at risk, as well as shellfish providers (industry and restaurants), appears to be the only effective measure for preventing infection with *V vulnificus*.

This paper reviews recent information about this organism to increase awareness of its dangers to the public.

CHARACTERISTICS OF THE ORGANISM

The genus *Vibrio* contains several human pathogens of which *Vibrio cholerae*, *Vibrio parahaemolyticus* and *Vibrio vulnificus* are the most common disease-causing organisms. Other pathogenic species include *Vibrio fluvialis*, *Vibrio mimicus*, *Vibrio alginolyticus* and *Vibrio metchnikovii* (4). In this paper they will be referred to as pathogenic vibrios (PV).

V vulnificus is the most virulent species of noncholera vibrios. It is found in estuarine seawaters of temperate and tropical climates and is associated with various marine life forms (5). Because molluscs are filter-feeders, they strain and concentrate particulate matter including *V vulnificus*. Therefore, the organism has been found in high concentrations in oysters and other shellfish from different parts of the world. In North America, *V vulnificus* is prevalent in areas bordering the Gulf of Mexico. Coincidentally, these areas also have the largest number of reported illnesses and deaths attributed to shellfish consumption. However, the organism has also been isolated from cooler waters, and molluscan shellfish sampled from other locations (including Maryland, New England, Maine, Nova Scotia, New Brunswick, Prince Edward Island [PEI], British Columbia and California) where the incidence of disease is very low or not reported.

This Gram-negative curved rod is motile, oxidase positive and ferments glucose and cellobiose. It is an obligate halophile requiring an optimum sodium chloride concentration between 1% and 3% for growth under laboratory conditions (1). In nature, a combination of water temperature and salinity plays an important role in its survival (6). In seawater, it is more prevalent at temperatures above 20°C and at salinities of 0.7% to 1.6%. It is rarely found in water cooler than 17°C (7,8). Recently, however, *V vulnificus* has been isolated from oysters in water with temperature as low as 7.6°C (9).

CHARACTERISTICS OF DISEASE AND EPIDEMIOLOGY

V vulnificus causes three distinct clinical syndromes: primary septicemia, gastroenteritis and wound infection. This organism is unusual in that it has the ability to cause infection by two different routes of entry, either by mouth or through skin lesions. The most susceptible are individuals with underlying illness. Raw oysters and seawater have consistently been implicated in the epidemiology of this disease. Following ingestion of the bacterium, a primary septicemia with a high case fatality rate occurs. Entry of the bacterium through a skin lesion usually results in a lower overall fatality rate. Each syndrome is described below.

Primary septicemia: Primary septicemia, the most severe form of disease, occurs when food containing *V vulnificus* organisms is consumed. The incubation period before onset of symptoms is quite short, ranging from as little as 7 h to several days. Median incubation periods ranging from 16 to 38 h have been reported (1). Symptoms listed in decreasing order of frequency include fever, chills, hypotension, nausea, vomiting, diarrhea, abdominal pain and secondary skin lesions. A sharp drop in blood pressure can lead to intractable shock and death. Seventy-five per cent of patients experience painful skin lesions (7). The skin initially appears red and quickly develops blisters that erode into necrotic ulcers. Severe acute inflammation may force either debridement or amputation.

More than 95% of patients with primary septicemia have pre-existing chronic illness, and over 50% of these patients die. The time between exposure and death is usually only a few days, but patients dying within 2 to 24 h of admission to hospital have frequently been reported (1,10); a median time from admission to death is 48 h or less (11,12). Many deaths occurred despite extensive use of a wide variety of antibiotics. Infections seemed to have been well involved by the time a patient sought medical attention. Experimental studies have revealed tetracycline to be the most effective of the antibiotics evaluated (1,7).

Gastroenteritis: Consumption of food containing *V vulnificus* may also cause gastroenteritis. Patients experience relatively milder symptoms than in septicemia. Symptoms of gastroen-

TABLE 1
Summary of the signs, symptoms and risk factors associated with *Vibrio vulnificus* primary septicemia

	Primary septicemia			
Signs, symptoms and risk factors	**Klontz et al (14)**	**Park et al (15)**	**Chang et al (8)**	**Tacket et al (12)**
Number of patients	38	70	14	18
Mean age (years)	62.5	51	53.6	56.4
Age range (years)	23–84	–	23–69	–
Sex (male/female)	33/5	67/3	10/4	13/5
Temperature at admission	>37.8°C	–	–	–
Leukocyte count (/L)	–	Leukopenia 14/59 Leukocytosis 20/59	8 (44%) $>1.0\times10^{10}$* 6 (33%) $<4.0\times10^{9}$*	–
Platelet count (/L)	–	Thrombocytopenia 26/38	12 (67%)* $<1.0\times10^{11}$	–
Symptoms	**N (%)**	**N (%)**	**N (%)**	**N (%)**
Systemic				
Fever†	35 (92%)	38 (54%)	14 (100%)	17 (94%)
Chills	20 (53%)	23 (33%)	13 (93%)	16 (91%)
Mental status change‡	19 (50%)	–	5 (36%)	–
Hypotension§	13 (32%)	38 (54%)	11 (79%)	6 (33%)
Gastrointestinal				
Diarrhea	16 (42%)	23 (33%)	4 (29%)	7 (40%)
Abdominal pain	13 (34%)	26 (37%)	–	8 (44%)
Vomiting	16 (42%)	14 (20%)	3 (21%)	8 (46%)
Skin				
Cellulitis	19 (50%)	–	–	–
Bullae	14 (37%)	29 (42%)	12 (86%)	–
Ecchymosis	13 (32%)	–	–	–
Cutaneous lesions	–	63 (91%)	12 (86%)	12 (67%)
Risk factors				
Comorbid illness – liver disease				
Alcoholism	12 (32%)	30/65 (46%)	5 (36%)	9 (50%)
Other	13 (34%)	47/65 (72%)	9 (64%)	3 (17%)
Comorbid illness – nonliver related	24 (63%)	5/65 (8%)	–	3 (17%)
Consumption of raw shellfish	35 (92%)	44 (63%)	9 (64%)	16 (87%)
Wound exposed to seawater or handling shellfish	0 (0%)	–	1 (7%)	–

**Combined results for primary septicemia and wound infection cases (Table 2) reported by Chang et al (8); †Temperature >39.5°C; ‡Disorientation or lethargy; §Systolic blood pressure less than 85 mmHg. N Number*

teritis consist of vomiting, diarrhea and abdominal cramps. Affected patients usually do not have an underlying disease. They may require hospitalization, but rarely die (11).

Wound infections: Wound infections can occur when the organism enters skin lesions exposed to seawater or when skin is punctured while handling shellfish or from marine animal bites (1). Incubation periods as short as 4 h have been reported, with an average of 12 h. Symptoms typically begin with edema, erythema and intense pain around the infected site. Fluid-filled blisters often develop and progress to tissue necrosis. In its speed and severity, this process resembles gas gangrene. In 50% of cases, surgical debridement or amputation is required to stop the spread of the organism into the bloodstream, which can result in septicemic death (12,13). In general, mortality rates for wound infections are approximately 25%, but for patients with a pre-existing chronic illness, they can be greater than 50% (1).

Summaries of clinical signs, symptoms and risk factors associated with many cases (8,12,14,15) are shown in Tables 1 and 2. Additional information can be obtained from recent reviews and case studies (1,2,10,11,13,16-19).

SOURCES OF INFECTION

The main sources of *V vulnificus* infection are raw or undercooked molluscan shellfish. Of the primary septicemia cases reported to the Centers for Disease Control and Prevention (CDC), Atlanta, Georgia, until 1991, 100% of cases were associated with the consumption of raw or undercooked oysters (20). More recently, raw clams have been also implicated (21). In most of the American cases, *Crassostrea virginica*, the

TABLE 2
Summary of the signs, symptoms and risk factors associated with *Vibrio vulnificus* wound infections and gastroenteritis

	Wound infections			Gastroenteritis
Signs, symptoms and risk factors	**Klontz et al (14)**	**Chang et al (8)**	**Tacket et al (12)**	**Klontz et al (14)**
Number of patients	17	4	9	7
Mean age (years)	61	66.5	52.4	66
Age range (years)	–	56–75	–	–
Sex (male/female)	16/1	3/1	7/2	3/4
Temperature at admission	>37.8°C	–	–	>37.8°C
Symptoms	**N (%)**	**N (%)**	**N (%)**	**N (%)**
Systemic				
Fever*	11 (65%)	4 (100%)	8 (88%)	4 (57%)
Chills	5 (29%)	4 (100%)	9 (100%)	3 (43%)
Mental status change†	3 (18%)	1 (25%)	–	0 (0%)
Hypotension‡	2 (12%)	2 (50%)	2 (22%)	0 (0%)
Gastrointestinal				
Diarrhea	1 (6%)	2 (50%)	1 (12%)	7 (100%)
Abdominal pain	0 (0%)	–	0 (0%)	7 (100%)
Vomiting	1 (6%)	2 (50%)	5 (50%)	2 (29%)
Skin				
Cellulitis	15 (88%)	–	–	0 (0%)
Bullae	7 (41%)	2 (50%)	–	0 (0%)
Ecchymosis	3 (18%)	–	–	0 (0%)
Cutaneous lessions	–	4 (100%)	2 (22%)	–
Risk factors				
Comormid illness – liver disease				
Alcoholism	–	1 (25%)	–	–
Other	2 (12%)	–	1 (12%)	2 (29%)
Comormid illness – nonliver related	6 (35%)	2 (50%)	4 (44%)	–
Consumption of raw shellfish	0 (0%)	–	–	5 (71%)
Wound exposed to seawater or handling shellfish	15 (88%)	4 (100%)	8 (88%)	–

**Temperature higher than 39.5°C; †Disorientation or lethargy; ‡Systolic blood pressure less than 85 mmHg. N Number*

eastern oyster harvested in the Gulf of Mexico during warm months was involved (22). About 85% of all reported cases were associated with freshly opened oysters consumed raw or undercooked in restaurants. Remaining cases were from shellfish purchased from retail or wholesale markets (11). Retail shucked oysters have not been incriminated in illness. *V vulnificus* has also been found in oysters harvested during the summer from the northern Atlantic coast, eg, Maryland (9), Maine (23), Nova Scotia (24), PEI (25), and the Pacific coast, eg, British Columbia (26) and California (27). These oysters reportedly have not been implicated in disease. Similarly, several species of bottom feeding fish from the Gulf of Mexico found to contain *V vulnificus* (28) were never implicated in disease, most probably because the fishes were not eaten raw.

Seawater has been a common source of wound infections. Large numbers of cases resulting from infection via skin have been reported in different parts of the world, eg, United States (18), Canada (29,30), Denmark (31,32) and Taiwan (8).

POPULATION AT RISK

Certain individuals who have a pre-existing chronic illness – such as liver disease including cirrhosis, hemochromatosis and chronic alcohol abuse; diabetes mellitus; immune disorders associated with AIDS, cancer and steroid or immunosuppresant therapy; and stomach and intestinal disorders – are at higher risk of infection than the general public (19). For cases of primary septicemia, between 60% and 75% of patients have pre-existing liver disease or chronic alcoholism, while another 15% to 20% of patients have iron storage diseases such as hemochromatosis or chronic diseases of the immune system (11).

Although most patients with primary septicemia have pre-existing chronic illness, they do not appear to be more sensitive than healthy people to wound infection. Once infected, however, they are at higher risk of developing bacteremia and possibly dying (11).

INFECTIOUS DOSE

The infectious dose for healthy individuals is not known. Reported estimates are as low as 1 colony forming unit (CFU) (33) and less than 100 CFU (34) per predisposed persons with elevated serum iron concentrations, or 100 to 1000 CFU/g of oyster meat (22). The number of raw oysters consumed by patients who died varied from one to about two dozen, but the concentration of *V vulnificus* in these oysters was not known (11). In one fatal case, analysis of oysters obtained from the implicated lot at the restaurant showed *V vulnificus* levels to

be 900 CFU/g of oyster meat (22). A dose of 1 CFU per person listed above appears too low, and supportive information for this value is lacking. Generally, it has been very hard to locate implicated oysters several days after the reported infection, making assessment of bacteria levels in implicated oysters difficult (22).

DOCUMENTED CASES OF *V VULNIFICUS* INFECTION

United States: Most *V vulnificus* infections are reported in the southeastern United States, and no outbreaks involving two or more individuals have been recorded by the CDC (11,20). So far, cases of infection have been reported in at least 14 states (19). In Florida between 1981 and 1993, 114 persons were hospitalized, with 50 deaths reported (35,36). Reports included 71 cases of primary septicemia, 34 of wound infections and nine of gastroenteritis. In California, during approximately the same time period (1981 to 1992), 24 cases resulted in 18 deaths (37). Infections showed a seasonal pattern, with most occurring from March through December and the highest frequency of cases occurring between May and October. Oysters, harvested from the Gulf of Mexico and consumed raw or undercooked, were implicated as the main source of illness. Of patients who died, about 70% had pre-existing liver disease. In 1995, 23 cases resulted in 10 deaths; clams were implicated in four cases (21). There are limited data available before 1988 because *V vulnificus* infection was not a reportable disease, except in Florida. Since 1987, other Gulf states (Alabama, Louisiana, Texas and Mississippi) have formed a surveillance system.

Canada: *V vulnificus* infection is not a reportable disease in Canada; therefore, information about infection with this organism is lacking. Out of several illnesses caused by pathogenic *Vibrio* species (PV) only infection by *V cholerae* must be reported. The limited information available on infections caused by *V vulnificus* and other PV is outlined below.

There are no published reports of any foodborne infections caused by *V vulnificus*, although this organism is present in Canadian waters and shellfish during warm summer months on the east and west coasts (24-26). One *V vulnificus* wound infection was reported 10 years ago; it involved an alcoholic male who punctured his skin during the summer on the shore of New Brunswick (29). Recently, reference was made to another person who contracted an infection while swimming in the ocean in the Vancouver area (30).

Infection from other pathogenic *Vibrio* species have been reported. From 1985 to 1994, there were 22 reported cases of cholera (38). Information about infections with other *Vibrio* species is lacking. To the authors' knowledge, only one paper, a note and a reference on marine vibrio infections acquired in Canada have been published (29,39,40). All reported were wound infections, two cases of *V alginolyticus* infection and two cases of *V vulnificus* infection.

The evidence, obtained from the Laboratory Centre for Disease Control (LCDC), indicated that the number of cases of vibrio infections occurring in Canada is very small (personal communication). All cases of *V cholerae* 01 and 0139 were acquired by persons travelling abroad, while infections with *V cholerae* non-01 and *V parahaemolyticus* were mostly acquired domestically. Even more rare are infections with *V alginolyticus*, *V mimicus* and *V fluvialis*. The epidemiological background for most of the infections except for *V cholerae* 01 and 0139 is incomplete or lacking.

Other countries: Reported cases of infection with *V vulnificus* for the period from 1981 to 1992 from several countries reveals over 300 cases of primary septicemia and over 100 wound infections, resulting in over 200 deaths (40). Cases and deaths have been reported throughout the world: India (41), Korea (15), Taiwan (8,42), Hong Kong (43), Australia (10), Denmark (31,32), Belgium (44), Sweden (45), The Netherlands (46,47) and other countries. It is unclear whether the recent increase in reported cases of infection represents a true increase in incidence or improved diagnosis and reporting. In the majority of primary septicemic cases, deaths were related to the consumption of raw oysters by persons with underlying illness. Wound infections, contracted after exposure to seawater during activities, such as fishing, bathing, handling oyster shells or eels, etc, resulted in some deaths.

HEALTH RISK FROM *V VULNIFICUS* INFECTION IN CANADA

Infections from *V vulnificus* in Canada can occur from shellfish that is either harvested domestically or imported, and from contact of ruptured skin with seawater in summer months.

Domestically harvested shellfish: *V vulnificus* has been found in both Canadian coastal waters and in shellfish during the summer months (water temperature greater than 19°C). On the east coast, *V vulnificus* has been isolated from mussels and seawater in seven recreational areas around Halifax in 1988 (24); clams and mussels in New Brunswick in 1991 and 1992 (personal communication); and oysters and mussels from six river systems in PEI in 1991 and 1992 (25).

The Halifax study (24) demonstrated that the majority (72%) of water samples contained up to 11 different PV species. *V alginolyticus* was predominant, while *V vulnificus* and *V cholerae* were more prevalent in the mussels than in the waters from which the mussels were harvested. There were no PV-associated infections documented among patients presenting to emergency rooms over the study period. In PEI, the most prevalent PV were *V alginolyticus* (7.1%) and *V parahaemolyticus* (4.7%). *V vulnificus* of biotype 2 was present in 6.7% of the oysters and 2.4% of the mussels analyzed.

The presence of biotype 2, which is pathogenic for eels and is differentiated from biotype 1 on the basis of the indole reaction, had not been previously reported in Canada. Biotype 2 has generally not been associated with human illness, and it was accepted that only biotype 1 is pathogenic for humans (48). However, recent reports may indicate otherwise: biotype 2 was isolated from a patient with septicemia and skin lesions in The Netherlands (46); and clinical strain ATCC 33817, originally isolated from a human leg wound and classified only as *V vulnificus*, was found to belong to biotype 2 (49).

Oysters collected from natural and cultivated populations in British Columbia during the summers of 1984 and 1985

also revealed the presence of PV (26,30). The most commonly isolated organisms were *V parahaemolyticus*, *V fluvialis* and *V vulnificus*. These were more prevalent in oysters from natural sources than from cultivated commercial stocks. Although 50% of the oysters analyzed contained PV, *V vulnificus* was recovered in only 21% of them. This organism was also isolated from protected estuarine environments, but only when water temperatures exceeded 20°C (30).

These results indicate that oysters harvested from the warm domestic waters contained PV including *V vulnificus*. The highest quantity of oysters consumed in eastern and central Canada comes from PEI, where the main harvesting season is between May and December. Because a considerable number of these oysters are marketed and reportedly consumed raw (personal communication), consumers with underlying disease could be at risk. Oysters from British Columbia do not represent such a risk because they are reportedly sold as shucked and not consumed raw (personal communication).

Imported shellfish: Of greater risk to Canadians are imports from the Gulf of Mexico because oysters harvested there have been consistently associated with infections and fatalities in the United States. Gulf oysters comprise about 3% of the total oyster consumption in Canada. They are imported throughout the year to Quebec (85%) and Ontario (15%), with the majority arriving between October and May. Import data for 1993 and 1994 showed that about 40% of the yearly quantity arrived in November (50).

In 1995, a collaborative survey conducted by Health Canada and the Department of Fisheries and Oceans showed that oyster shipments received between January and April did not contain *V vulnificus*. However, substantial levels of the organism were detected in shipments received between May and November, with the highest concentrations in July and August (unpublished data). These findings parallel results of Gulf oyster analyses conducted in the United States, where the highest concentrations of *V vulnificus* were detected in the summer (51). They are also in agreement with a study showing that *V vulnificus* survived in shellstock for at least 14 days at 2 to 3°C (52). Therefore, when high levels of this organism are present at harvest the levels are not likely to be significantly reduced during transport and storage of oysters at low temperature.

Although the majority of Gulf oysters are imported during the cold months, when *V vulnificus* levels are low or not detectable at the point of harvest, generally there has been a small, but steady supply of contaminated oysters entering the Canadian market from April through October when concentrations of the organism can be high. If such oysters are consumed raw or undercooked, they represent a great health risk to consumers, especially to persons with underlying diseases.

Seawater: Because *V vulnificus* has been found off both Canadian coasts during the warm summer months (24-26), people with skin lacerations exposed to seawater are at risk of contracting infection. The outcome of infection is more serious for individuals with underlying disease, but persons in apparently good health have also been affected (1,53).

It should be noted that the mere presence of *V vulnificus* in oysters or seawater is not an indication that this organism will cause disease in humans. Because the factor(s) responsible for the pathogenicity of *V vulnificus* have not been elucidated, means are not available to predict whether strains present in shellfish are virulent for humans. Also, oysters harvested from the same location can harbour a wide variety of strains; for instance, analysis of three oysters in Florida showed that they contained 60 different *V vulnificus* genotypes (54). It is possible that strains of *V vulnificus* present in Canadian shellfish might not be pathogenic. This notion derives from the observation that oysters harvested from the northern coasts of the United States and Canada contained the organism, but these oysters have never been implicated in foodborne infections.

CONCLUSIONS

V vulnificus represents a potential health risk to Canadians. Physicians should warn patients with underlying illness, particularly those with liver diseases and iron overload, about the risk of consuming raw molluscan shellfish because the shellfish may contain *V vulnificus*. Especially dangerous are imported oysters harvested in the Gulf of Mexico between April and October. Another source of infection to people in high risk categories as well as the general population is exposure of skin lesions to warm seawater during summer months. In addition, susceptible individuals travelling during the summer on the Gulf coast in the southern United States should be warned of the dangers presented by this organism.

Because of the speed at which this disease advances, the timing of medical intervention is critical. Persons developing disease symptoms within a day or two after consumption of raw or undercooked molluscan shellfish or after exposure of open skin to seawater should seek immediate medical attention. Physicians have to become more familiar with the diagnosis and treatment of this disease. Appropriate antibiotic treatment should be administered immediately, and in parallel, laboratories should culture specimens from suspected cases on media appropriate for the isolation of *V vulnificus* and refer isolates to LCDC for confirmation. Suspected cases of *V vulnificus* infection should also be reported to the local and provincial health departments so that appropriate investigation and prevention measures can be undertaken.

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