Possible transmission of human herpesvirus-8 by blood transfusion in a historical United States cohort

Sheila C. Dollard, Kenrad E. Nelson, Paul M. Ness, Veronica Stambolis, Matthew J. Kuehnert, Philip E. Pellett, and Michael J. Cannon

BACKGROUND: Transmission of human herpesvirus-8 (HHV-8) by blood transfusion in the United States appears plausible but has not been demonstrated. The objective of this study was to evaluate evidence of HHV-8 transmission via blood transfusion.

STUDY DESIGN AND METHODS: Serum specimens were collected before and 6 months after surgery from 406 patients who enrolled in the Frequency of Agents Communicable by Transfusion study (FACTS) in Baltimore, Maryland, from 1986 to 1990. The change in HHV-8 serostatus was measured by a lytic-antigen immunofluorescence assay.

RESULTS: Of the 284 patients who were initially HHV-8-seronegative and who received transfusions, 2 seroconverted, 1 with a postsurgery antibody titer of 1:160 and the other with a titer of 1:1280. These patients received 12 and 13 units of blood, respectively. None of the HHV-8-seronegative patients who did not receive transfusions seroconverted. If seroconversion was caused by transfused blood, the transmission risk per transfused component was 0.082 percent.

CONCLUSIONS: This is the first report suggesting transmission of HHV-8 via blood components in the United States. Because linked donor specimens were not available, other routes of transmission cannot be excluded; however, the evidence is consistent with infection being caused by transfusion. Future studies should include contemporary US populations with linked donor specimens and populations at higher risk for HHV-8 infection.

Human herpesvirus-8 (HHV-8), also known as Kaposi's sarcoma (KS)-associated herpesvirus, is the cause of KS and is associated with primary effusion lymphoma and multicentric Castleman's disease.[1] Evidence that HHV-8 could potentially be transmitted by blood transfusion was first reported by Blackbourn and colleagues[2] who isolated infectious HHV-8 from five of seven donations from one blood donor. Subsequent studies found an association between injection drug use and HHV-8 infection, suggesting that blood-borne transmission of HHV-8 can occur through needle sharing,[3-7] although others did not find this association.[8,9] HHV-8 transmission has also been traced to the transplant of infected organs.[10]

Limited studies in the United States and Jamaica suggest that donated HHV-8-seropositive blood seldom contains infectious virus: none of 32 recipients of blood components from HHV-8-seropositive donors developed antibodies against HHV-8,[11,12] and none of 33 HHV-8-seropositive blood donors had HHV-8 DNA in their peripheral blood mononuclear cells.[13] In contrast, studies in Uganda and Tanzania, where HHV-8 and KS are more common, found HHV-8 DNA in blood donors[14] and found

ABBREVIATIONS: EBV = Epstein-Barr virus; FACTS = Frequency of Agents Communicable by Transfusion study; HHV-8 = human herpesvirus-8; IFA = immunofluorescence assay; KS = Kaposi's sarcoma.

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that HHV-8 seropositivity in children correlated with the number of blood transfusions they had received.[15]

To further investigate possible transfusion-related transmission of HHV-8, we tested for HHV-8 antibodies in serum samples from a historical cohort of 406 US cardiac surgery patients, many of whom received multiple blood transfusions.

MATERIALS AND METHODS

Study design and population

We randomly selected 406 cardiac surgery patients (primarily receiving coronary artery bypass) who enrolled in the Frequency of Agents Communicated by Transfusion study (FACTS) in Baltimore, Maryland, from 1986 to 1990.[16] For quality control (QC), specimens were collected from patients independently by trained staff dedicated to the study. The median age of these patients was 65 years, 66 percent were men, 90 percent were white, and 81 percent received blood transfusions during surgery (mean, 8.6 units). Two serum specimens were obtained from each patient, one before surgery and another 6 months after surgery. Genetic testing to confirm that pre- and postsurgery specimen pairs were from the same patient was not available, but rigorous QC in the collection and labeling procedure made specimen mislabeling unlikely.

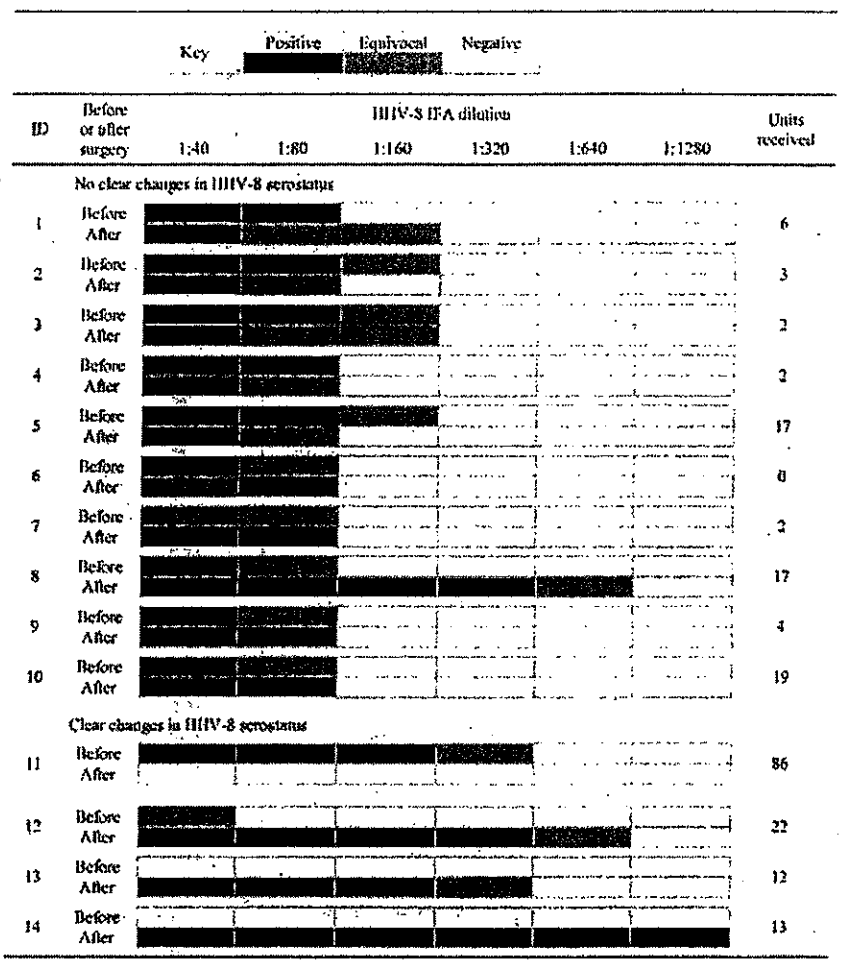

Fig. 1. FACTS patients (n = 14) with discordant HHV-8 IFA results on pre- and postsurgery serum samples at 1:80 serum dilution, showing endpoint antibody titer and number of blood products received.

Serologic analysis

HHV-8 immunoglobulin G antibody was measured, with an immunofluorescence assay (IFA) based on lytically induced BCBL cells that harbor HHV-8, as described,[13] except a higher serum dilution was used as the assay cut-off in our study. Specimens were screened at a 1:40 serum dilution, and reactive serum samples were confirmed at 1:80 and 1:160 serum dilutions, with reactivity at 1:80 considered positive. All serum samples were randomized and blinded to the person reading the slides. We determined endpoint titers for all serum samples from patients with discordant pre- and postsurgery results at 1:80 dilution (Fig. 1). To further ensure specificity, seroconverters were defined as those with a negative (not equivocal) presurgery IFA result at a 1:40 dilution and with a positive postsurgery result at a 1:80 dilution.

In addition, to rule out cross-reactivity with the closely related Epstein-Barr virus (EBV), we measured EBV antibodies by enzyme-linked immunosorbent assay (ELISA, DiaSorin, Stillwater, MN) before and after surgery in the 14 patients in Fig. 1 who showed a change in HHV-8 antibody reactivity.

RESULTS

Overall, HHV-8 seropositivity among patients before surgery was 11.3 percent. Concordance of HHV-8 antibody status in patients before and after surgery was 96.6 percent: 351 patients (86.5%) were negative at both visits, and 41 (10.1%) were positive at both visits. Most HHV-8-seropositive patients (72%) had antibody titers of 1:160 or greater. Fourteen patients (3.4%) had discordant HHV-8 results between their paired pre- and postsurgery

TABLE 1. Demographics, surgery, and transfusion characteristics of FACTS HHV-8 seroconverters and all FACTS patients

Patients	Age (years)	Race	Sex	Surgery date	Surgery type*	Number of units transfused by type: Whole blood	Cryo-precipitate	RBCs	PLTs	FFP	Total
FACTS seroconverters											
Patient 13	67	White	Male	Feb. 1988	CAB	0	0	4	8	0	12
Patient 14	69	White	Male	Jan. 1988	CAB	0	0	5	8	0	13
All FACTS patients											
Median	64					0	0	2	0	0	3
10%-90% range	46-75					0-0	0-1	0-6	0-8	0-2	0-17

* CAB = coronary artery bypass.

serum samples at the assay cutoff of 1:80 (Fig. 1); most of these (Patients 1-10) were equivocal results paired with relatively weak positive results that likely represented fluctuation of antibody levels over time around the detection limit of the assay.

Four patients (Patients 11-14) showed a clear change in HHV-8 serostatus (Fig. 1), and two of them (Patients 13 and 14) met the case definition for seroconverter, with postsurgery antibody titers of 1:160 and 1:1280. Patient 12 had a high postsurgery HHV-8 antibody titer and may have been a seroconverter, but was excluded because of an equivocal presurgery IFA at 1:40 dilution. The fourth patient (Patient 11) showed evidence of seroreversion with an antibody titer of 1:160 before surgery and negative HHV-8 serology results after surgery. This patient received an unusually large number of transfusions (86 units, nearly all likely to be seronegative with a seroprevalence of 2.4% in 1000 US blood donors with this assay[13]), which may have been a factor in the change in his measurable antibody to HHV-8. All patients tested were seropositive for EBV before and after surgery. EBV ELISA optical densities (which approximate antibody titer) for Patients 11 to 14 before and after surgery, respectively, were 2.2/2.3; 3.0/2.9; 2.9/1.2; and 0.8/0.9.

The two unambiguous seroconverters (Patients 13 and 14) received 12 and 13 units of blood, respectively, including red blood cells (RBCs) and platelets (PLTs; Table 1). Rates of seroconversion were 2 per 142 person-years of follow-up (284 individuals × 0.5 years) for the transfused group compared to 0 per 37.5 person-years of follow-up (75 individuals × 0.5 years) for the nontransfused group ($p = 0.63$).

DISCUSSION

We identified two patients with possible transmission of HHV-8 by blood transfusion as evidenced by seroconversion. Neither of the two HHV-8 seroconversions could be explained by cross-reactivity with antibodies to EBV, a closely related virus. To our knowledge, this is the first report suggesting a link between HHV-8 infection and blood transfusion in the United States.

Because linked donor specimens were not available, it is possible that seroconversion was due to other sources of infection. Detailed clinical information was not available for the two seroconverters; however, the most likely source other than transfusion would be frequent sexual exposure to persons at high risk of HHV-8 shedding, such as HIV-infected individuals or men who have sex with men. Because older and less healthy individuals, such as FACTS patients, are less likely to engage in high-risk sexual behavior, transfusion transmission is a more plausible explanation for seroconversion.

If we assume that the two seroconverters were infected via transfused blood, the transmission risk per transfused patient was 2 in 284 or 0.7 percent (95% confidence interval [CI], 0.0%-1.7%). If we also assume that each received only 1 unit of infected blood, then we would estimate the risk of HHV-8 infection per transfused unit to be 2 in 2440 or 0.082 percent (95% CI, 0.0%-0.20%). This rate is approximately one-fifth that of hepatitis C virus (HCV) transmission before the implementation of screening with surrogate markers and anti-HCV tests.[17]

There are several reasons why previous studies[11,12] of the possible transmission of HHV-8 via transfusion may not have identified HHV-8 seroconverters. First, assays used previously have been shown to be less sensitive than our lytic IFA.[13,18,19] In two multicenter studies of HHV-8 serologic assays,[13,19] the lytic IFA was identified as the most sensitive assay, with moderate specificity in the first study at 1:10 serum dilution and high specificity in the second study at 1:40 serum dilution. With further assay validation, our laboratory increased specificity of the lytic IFA with a very small loss in sensitivity by setting the assay cutoff at 1:80 dilution (manuscript in preparation). Second, the types of blood components mainly transfused in the two previous studies (e.g., plasma, cryoprecipitate) would be less likely to harbor viable HHV-8 (which is primarily cell-associated) than cellular components such as RBCs and PLTs, which patients in the FACTS cohort received. And

third, given our estimated rate of seroconversion (0.7%) and the small number of recipients in two previous studies (32 total), sampling probabilities could explain the absence of transfusion-related transmission.

In conclusion, our results suggest that transmission of HHV-8 via blood transfusion occurred among FACTS patients. Any current HHV-8 transfusion-related transmission risk in the United States is most likely less than our estimated risk of 0.082 percent per unit, because blood safety practices have changed significantly since FACTS was conducted. Donor deferral criteria are more stringent, donations are tested for HIV and HCV (which share some risk factors with HHV-8), and cellular blood components are routinely leukoreduced (HHV-8 is primarily cell-associated). HHV-8 infection does not appear to pose serious consequences for immunocompetent individuals, who rarely develop KS unless they become immunosuppressed. Many people who receive blood transfusions, however, including organ transplant recipients, are immunosuppressed and thus are at risk for developing HHV-8-related complications. An intervention to screen blood for HHV-8 should consider the risks of HHV-8 transmission and the feasibility of screening, but it should also consider the impact of screening on the availability of blood components. Future studies should use linked donor-recipient specimens and include contemporary US populations and non-US populations with higher rates of HHV-8 infection. Finally, if future studies demonstrate HHV-8 transfusion transmission, HHV-8 assays suitable for use in high-volume blood donor screening programs need to be developed.

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研究報告の概要

○サンタ・カタリナ州の保健局長官が3月31日に確認したところによると、原虫クルーズトリパノソーマ（シャーガス病の病因）に感染したオオサシガメがBR-101高速道路沿いにあるキオスク店で発見された。感染者の91%が、同店で作られたサトウキビジュースの摂取により感染したことが確認された。この昆虫は、2005年3月30日にキオスクの従業員が発見したが、商品のタオルに隠れていた。

オオサシガメのほかに、キオスク周辺で捕獲されたオポッサムの親1匹と子4匹からもクルーズトリパノソーマが検出された。このオポッサムは、キオスクの裏のサトウキビ保管庫にしかけた40個のトラップの一つで捕獲された。州疫学サーベイランス部によると、感染動物の捜索は半径4kmまで拡大する予定である。

全ての患者は、2005年2月13日にサトウキビジュースを摂取した。感染経路は確定されていないが、サトウキビがオポッサムにより汚染されたか、オオサシガメがジュース製造時に混入した可能性がある。3月31日の疫学サーベイランス部発表によると、シャーガス病患者24名が確認された。9日間で患者数が30名に達した。このうち4名は慢性のキャリアで、すでに症状が進行している。患者のうち2名は供血のために検査を行っており、2名は臓器移植を受けていた。

○ANVISA（国立衛生サーベイランス部）はサンタ・カタリナ州でのシャーガス病流行に対し、2005年2月1日から3月23日の間にBR-101高速道路のPicarrasとItaljaiの間のキオスクでサトウキビジュースを摂取した者からの供血を禁じた。

報告企業の意見	今後の対応
ブラジルのサンタ・カタリナ州でサトウキビジュースの摂取が原因と見られるトリパノソーマ症の集団感染が発生し、ブラジル当局により供血制限が行われたとの報告である。	日本赤十字社は、輸血感染症対策として問診時に海外渡航歴の有無を確認し、帰国後4週間は献血不適としている。また、シャーガス病の既往がある場合には献血不適としている。今後も引き続き情報の収集に努める。

使用上の注意記載状況・その他参考事項等

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血液を介するウイルス、細菌、原虫等の感染
vCJD等の伝播のリスク

(一千)

ProMED情報(詳細)

記事番号	20050402-0020
重要度	C
タイトル	PROTrypanosomiasis, foodborne - Brazil (Santa Catarina)(05)
感染症名	トリパノソーマ症
主症状	
日付	2005/04/01
流行国	ブラジル
和訳概要	トリパノソーマ症,食品由来 - Brazil(Santa Catarina) (05) [1]情報源:O Folha online [翻訳編集:ポルトガル人モデレーターMPP] キオスクの従業員がSanta Catarinaでシャーガス病の媒介動物に暴露 Santa Catarinaの保健局長官が3月31日に確認したところによると、原虫クルーズトリパノソーマ_Trypanosoma cruzi_(シャーガス病の病因)に感染したbarbeiro [オオサシガメ]がFlorianopolisから113km離れたNavegantesにあるキオスクBarracao da Penha 2 店で発見された。感染者の91%が、同店で作られたサトウキビジュースの摂取により感染したことが確認された。検査は Santa Catarina連邦大学の微生物寄生虫学部により行われ、この昆虫の原虫の存在が証明された。この昆虫は、BR-101高速道路111km地点沿いにある同店内で、2005年3月30日にキオスクの従業員が発見したが、キオスクの商品であるタオルに隠れていた。 オオサシガメのほかに、[キオスク]周辺で捕獲された親のオポッサム1匹と子オポッサム4匹からもクルーズトリパノソーマが検出された。このオポッサムは、キオスクの裏のサトウキビ保管庫にしかけた40個のトラップの一つで捕獲された。州疫学サーベイランス部によると、感染動物の検索は半径4kmまで拡大する予定である。 全ての患者は、2005年2月13日にサトウキビジュースを摂取した。サーベイランス部は現在、同病が確認されたが、Navegantesのキオスクと接触がなかったJoinville (首都からの180kms)在住の2人を調査している。感染経路は確定していない。サトウキビがオポッサムにより汚染されたか、オオサシガメがジュース製造時に混入した可能性がある。3月31日の疫学サーベイランス部発表によると、シャーガス病患者24名が確認された。9日間で患者数が30名に達した。このうち4名が慢性のキャリアで、すでに症状が進行している。そのうち2名は献血のために検査を行っており、2名は臓器移植を受けていた。 [2]情報源:EPTV Central, 2005/3/31 ANVISA (国立衛生サーベイランス部)はSantaCatarinaでのシャーガス病流行に対し、献血での供血に対しスクリーニングを追加することを発表した。 2005年2月1日から3月23日の間にBR-101ハイウエイのPicarrasとItaljaiの間のキオスクでサトウキビジュースを摂取した者からの供血を禁じた。

情報詳細【和文】

トリパノソーマ症,食品由来 - Brazil(Santa Catarina) (05)
[1]情報源:O Folha online [翻訳編集:ポルトガル人モデレーターMPP]
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オオサシガメのほかに、[キオスク]周辺で捕獲された親のオポッサム1匹と子オポッサム4匹からもクルーズ

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情報詳細【英文】

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To: promed-ahead-edr@promedmail.org
From: ProMED-mail <promed@promed.isid.harvard.edu>
Subject: PRO/AH/EDR> Trypanosomiasis, foodborne - Brazil (Santa Catarina)(05)
X-ProMED-Id: 20050401.0940
Sender: owner-promed-ahead-edr@promed.isid.harvard.edu
Reply-To: promedNOREPLY@promed.isid.harvard.edu
Precedence: bulk
TRYPANOSOMIASIS, FOODBORNE - BRAZIL (SANTA CATARINA) (05)
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A ProMED-mail post
<http://www.promedmail.org>
ProMED-mail is a program of the
International Society for Infectious Diseases
<http://www.isid.org>
[This thread name has been changed to "Trypanosomiasis, foodborne - Brazil (Santa Catarina)" from "Trypanosomiasis, foodborne - South America" because no cases have been reported from outside Brazil and the outbreak has been located to Santa Catarina. - Mods. EP/MPP]
[1]
Date: 1 Apr 2005
From: ProMED-mail <promed@promedmail.org>
Source: O Folha online [trans. from Portuguese Mod.MPP; edited]

<http://www1.folha.uol.com.br/folha/cotidiano/ult95u107470.shtml?>
Employees of kiosk encounter the vector of Chagas Disease in Santa Catarina

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The Secretary of Health of Santa Catarina confirmed this Thursday [31 Mar 2005] that a barbeiro [triatomid bug] was found in the kiosk Barracao da Penha 2, in Navegantes (113 km from Florianopolis), which was infected with the protozoan _Trypanosoma cruzi_ (the cause of Chagas disease). According to the agency, 91 percent of the infections [cases of Chagas disease] that were confirmed occurred through the ingestion of cane juice from this establishment. The test, conducted by the Department of Microbiology and Parasitology of the Federal University of Santa Catarina, proved the presence of the protozoan in this insect. The insect was found by employees of the establishment, which is located on the margins of the BR-101 highway at km 111, this past Wednesday [30 Mar 2005]. It was hidden in a towel -- a product that is also sold in this kiosk.
In addition to the barbeiro [triatomid bug], an adult opossum and four young that were captured near to the local [the kiosk] were also positive [for _Trypanosoma cruzi_]. The animals were trapped in one of the 40 traps behind the kiosk, an area where part of the sugar cane was stored. According to the Director of the State Epidemiologic Surveillance Unit, Luis Antonio Silva, the search for infected animals is continuing and will be extended for a radius of 4 kilometers.
"The situation is being clarified, providing a sense of security as to which persons have been exposed to the source of infection" he said. According to Silva, all of the sick individuals had ingested the sugar cane juice on 13 Feb 2005. The surveillance unit is still investigating 2 residents of Joinville (180 kms from the capital), who were confirmed with the disease, but did not have contact with the kiosk at Navegantes.
In addition, the form of transmission was not pointed out. One hypothesis is that the sugar cane had been infected by the opossum or the barbeiro [triomatid bug] in the storage area or that the insect was crushed during the preparation of the drink.
The Epidemiologic Surveillance unit revealed this past Thu [31 Mar 2005] that only 24 cases [of Chagas disease] were confirmed. There have been 9 days during which the number [of cases] has reached 30 [but confirmation is still pending]. According to Silva, 4 of the cases were chronic carriers of Chagas disease (they were already in an advanced state of the disease). Of these, 2 had undergone testing to donate blood, and the other 2 were organ recipients.
Another 2 cases will return for analysis, and therefore cannot be linked to the outbreak [as yet]. According to the Secretary of Health of Santa Catarina, Luiz Eduardo Cherem, there cannot have been a mistake. "I do not want to say that this was an error. Perhaps as a result of the overwhelming number of examinations performed there has been some confusion." According to him, although the transmission was accidental, all of the State agents involved in capture of the mosquito responsible for dengue fever will also be trained to capture the vector for Chagas disease. This will be the responsibility of the municipal surveillance units.
The ANVISA (National Agency for Sanitary Surveillance) divulged this past Thursday [31 Mar 2005] the launching of a line of credit for the vendors of sugar cane juice who want to make improvements in their establishments.
[Byline: Thiago Reis]
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[2]
Date: 1 Apr 2005
From: ProMED-mail <promed@promedmail.org>
Source: EPTV Central 31 Mar 2005 [Trans. and summarized from Portuguese by

Mod.MPP]
<http://eptv.globo.com/noticias/>
ANVISA (the National Sanitary Surveillance Unit), in response to the outbreak of Chagas Disease in Santa Catarina, has announced an additional screening step for blood donations. All persons who drank sugar cane juice from the kiosks along highway BR-101, between Picarras and Italjai, during the period 1 Feb 2005 through 23 Mar 2005 are to be considered inappropriate for blood donation. Questioning about this exposure history is to be added to the pre-existing questioning on health status and medication use. One person to date has been blocked from donating blood.
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[The fact that the infections have been pinned down to exposure on a single day will be comforting to people living in or passing through Santa Catarina State. Precise information on exposure can now be given.
The outbreak has disclosed an unknown potential for transmission of _Trypanosoma cruzi_ to many people in a very short time. - Mod.EP]
[see also:
Trypanosomiasis - Brazil (Amapa) 20050331.0929
Trypanosomiasis, foodborne - Brazil (Santa Catarina) (04) 20050330.0917
Trypanosomiasis, foodborne - Brazil (Santa Catarina) (03) 20050327.0884
Trypanosomiasis, foodborne - Brazil (Santa Catarina) (02) 20050325.0870
Trypanosomiasis, foodborne - Brazil (Santa Catarina) 20050324.0847
1998
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Trypanosomiasis - Brazil: RFI 19980306.0426
1997
———
Chagas disease - Latin America 19970114.0066
Chagas disease vector (05) 19970118.0105
1996
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Trypanosomes, New World, Symposium - Guyana 1996 19960830.1493]
.....mpp/ep/pg/mpp