Cost of Varicella in France: A Study in Day Care Centers

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To assess the cost of varicella in young children in France, a prospective study was done in day care centers. Children (1263), who were 3 months to 3 years old and attending day care, were followed over a varicella season. For every child who developed varicella (n = 200), detailed information was obtained by use of parental questionnaires. Questions concerned medical care, days missed from work for parents, and the need for extra baby-sitting. On average, each sick child had one consultation with a physician and received three medications. In half of the families (52%), at least 1 parent had to miss work an average of 4.5 days to care for a sick child. Total costs to society were estimated to be US$352 per family, with medical costs accounting for 22% of the cost. The average eventual cost to parents was $89 per family, including $80 of non-medical costs. This study emphasizes the important socioeconomic impact of varicella in the day care setting in France.

Materials and Methods

Study subjects. The study was conducted in a convenience sample of 51 DCCs in Lyon. Of ~120 DCCs in the city, only centers meeting predefined eligibility criteria and which volunteered their participation before the study began were included. For a DCC to be eligible for the study, children had to attend the participating center for the entire working day and for at least 4 days a week, and about half of the children attending the center had to be still susceptible to varicella, as assessed by a brief interview with the parents. All children attending a participating DCC were enrolled in the study and followed for varicella-zoster virus (VZV) infection from January to June 1995.

Parents who agreed to their child’s participation in the study filled out an initial questionnaire, providing information on the VZV infection status of all household members (a self-reported history of varicella or herpes zoster in both children and adults). Parents whose child(ren) attending day care developed varicella during the 6-month study period completed a second questionnaire, usually within a month of varicella onset. Detailed information on the varicella episode was obtained, including duration of the disease and complications; medical advice sought (nature and number of visits to general practitioners, specialists, or emergency care); medications used, whether prescribed or not; hospitalization; and laboratory tests and diagnostic procedures performed.

In addition, information was collected on days missed from work for parents or relatives to care for the sick child and days of extra baby-sitting that were required. The nature and number of work days missed were specified for every type of absence, including sick-child leave, sick-parent leave, paid vacation, and unpaid days off. This information was obtained for every child attending day care who had varicella, as well as for siblings when varicella occurred from 1 month before to 1 month after the index child’s illness.

Diagnostic assessment of varicella during the study was based on parental report. Comments on disruption of family life related to varicella were also sought.

Cost estimation. We computed costs both to society and to parents. Costs to society included all costs related to the disease, regardless of who paid them. The parental costs were those borne directly by parents after all reimbursements. Costs discussed in this
paper are from the societal perspective, unless otherwise specified. Medical and non-medical costs were calculated per day care varicella case and per family, considering all cases of childhood varicella in the family. Costs related to varicella in household adults were not taken into account. All costs were estimated as of 31 December 1995, after updating available sources of information when necessary. Costs are indicated here in US dollars (on the basis of 1 US dollar for 5 French francs, the exact exchange rate being 5.0 in December 1995).

Medical costs comprised the costs of physician visits, medications, and hospitalizations. In France, medical prices are set at a national level by the “Sécurité Sociale” (SS, a universal health care insurance system) on the basis of economic and regulatory considerations. The SS reimburses most medical expenses according to predetermined rates. Since the SS does not provide full coverage for all medical expenses (e.g., consultation of physicians and medications), full reimbursement may be obtained through complementary health insurance contracted on a voluntary basis.

To assess the cost to society of physician visits and consultations (referred to hereafter as physician visits), we used average prices for Lyon-based physicians, which take into account additional costs for night and weekend visits [10]. Physician visits are reimbursed to the family at a rate of 70% by the SS. Cost to the parents was computed on the basis of whether they had complementary health insurance or not. To estimate the cost of medications for children with varicella, the official prices set by the SS were used [11]. Medication costs were based on what was actually purchased. Cost to the parents was computed on the basis of whether the drug was prescribed (100% cost to the parents if not obtained by prescription) and whether parents had complementary health insurance (if not, the official rates of reimbursement by the SS were used). For hospitalizations, cost was computed on the basis of the exact daily charge in the unit where the child was hospitalized. Hospitalization charges are reimbursed to the parents at a rate of 80% by the SS.

Non-medical costs included the cost of work days missed by parents or relatives and the cost of extra baby-sitting. Additional costs, such as traveling expenses, were not taken into account. To evaluate the cost of work days missed by each parent, we used national estimates of net daily income by socioprofessional category [12]. Cost to parents was evaluated on the basis of the type of leave taken. Days of sick-child leave or paid vacation were assessed as incurring no cost to the parents. Net daily income was applied to unpaid days off. Sick leave (for use when a parent is sick and sometimes used to take care of a sick child) is partially reimbursed by the SS after a threshold of 3 non-reimbursed days. The non-reimbursed part was added to the parental costs. For extra baby-sitting, the exact expenses reported by parents were taken into account.

Statistical analysis. The analysis was mainly descriptive. Data were described by percentages or means ± SD and ranges (minimum to maximum). Comparisons were done using Student’s t test. For hypothesis testing, \( P < .05 \) (two-sided) was considered statistically significant. All analyses were done using SAS software (version 6.11 for Windows; SAS, Cary, NC) [13].

Results

Study cohort. A cohort of 1333 children (3 months to 3 years old) attending one of the participating DCCs was used for the study. Detailed information on household members was obtained for 1263 children, corresponding to a 95% participation rate. Data were obtained on a total of 1914 children (1263 children attending day care and their 651 siblings) and 2424 adults. Day care children (51% boys) were a mean age of 17 ± 8 months at the beginning of the study. Their siblings had an average age of 6 years. Children were usually residing with both their parents (89%), and most families (57%) had only 1 child. Children in the study were in good health and none was known to be immunocompromised.

Varicella cases. Over the 6-month study period, 200 enrolled children (including 7 pairs of twins) developed varicella in 193 families. Among the 193 families, 26 non-twin siblings of day care children also developed varicella. Detailed information on each VZV episode was obtained for all cases of varicella. (None of the children whose parents refused their participation in the study had varicella during the 6-month period.) The mean duration of the varicella episode, from first appearance of any rash to complete healing, was 15.7 ± 5.7 days (range, 6–34). Among the 200 children in day care who developed varicella, 15 (8%) presented 17 complications, two of which required hospitalization (febrile convulsions and thrombocytopenic purpura). Complications not requiring hospitalization were otitis or nasopharyngeal infections \((n = 7)\), cutaneous superinfections \((n = 5)\), respiratory complications \((n = 2)\), and eczema relapse \((n = 1)\). The child with thrombocytopenic purpura also had cutaneous superinfection, and another child presented with both respiratory complications and otitis.

Physician visits. Of the 200 children attending day care who developed varicella, 176 (88%) had a total of 207 physician visits, either at the physician’s office or at home. This represented an average of 1.0 ± 0.6 physician visits per varicella case, with the number of visits per child ranging from 0 to 4. Half of the physicians who were consulted were general practitioners. The average number of consultations for children with complications was significantly higher than that for children without complications (1.7 vs. 1.0; \( P < .001 \)).

Of the 193 families with at least 1 sick child, 176 (91%) saw a physician at least once. These families had a total of 223 physician visits for 226 cases of childhood varicella (i.e., an average of 1.2 ± 0.6 physician visits per family, ranging from 0 to 4 visits). The corresponding costs per varicella case among children attending day care and per family are presented in Table 1. When considering all 193 families, taking into account all cases of childhood varicella in the family, the average cost of physician visits was $34 ± $19 (range, $0–$125) per family.

Medications. Medications were recorded only for the children attending day care, not for siblings. Of the 200 children in day care with varicella, 192 (96%) received a total of 644 physician visits for 226 cases of childhood varicella (i.e., an average of 1.2 ± 0.6 physician visits per family, ranging from 0 to 4 visits). The corresponding costs per varicella case among children attending day care and per family are presented in Table 1. When considering all 193 families, taking into account all cases of childhood varicella in the family, the average cost of physician visits was $34 ± $19 (range, $0–$125) per family.

Statistical analysis. The analysis was mainly descriptive. Data were described by percentages or means ± SD and ranges (minimum to maximum). Comparisons were done using Student’s t test. For hypothesis testing, \( P < .05 \) (two-sided) was considered statistically significant. All analyses were done using SAS software (version 6.11 for Windows; SAS, Cary, NC) [13].
Table 1. Cost of physician visits for families of varicella-infected children between the ages of 3 months and 3 years who were attending day care centers in Lyon, France, between January and June 1995.

<table>
<thead>
<tr>
<th>Specialty of physician</th>
<th>Families with at least 1 visit</th>
<th>Total no. of visits</th>
<th>Cost to society (US $)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n/total (% of total)</td>
<td>Mean ± SD</td>
<td>Median (range)</td>
</tr>
<tr>
<td>All specialties</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost per case¹</td>
<td>175/200 (88)</td>
<td>207</td>
<td>30 ± 18</td>
</tr>
<tr>
<td>Cost per family²</td>
<td>176/193 (91)</td>
<td>223</td>
<td>34 ± 19</td>
</tr>
<tr>
<td>General practitioner</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost per case¹</td>
<td>95/200 (48)</td>
<td>108</td>
<td>14 ± 16</td>
</tr>
<tr>
<td>Cost per family²</td>
<td>98/193 (51)</td>
<td>119</td>
<td>15 ± 18</td>
</tr>
<tr>
<td>Pediatrician</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost per case¹</td>
<td>87/200 (44)</td>
<td>99</td>
<td>17 ± 21</td>
</tr>
<tr>
<td>Cost per family²</td>
<td>89/193 (46)</td>
<td>104</td>
<td>18 ± 22</td>
</tr>
</tbody>
</table>

* By definition, median of observed values is 0 if >50% of subjects have no event.
¹ Includes only children attending day care.
² Includes costs for all cases of childhood varicella in family (i.e., child attending day care and siblings, whenever appropriate).

the children received antibiotics, antiviral therapy, or corticosteroids, respectively. Most medications (85%) were prescribed by a physician. The average total cost of medications was $14 ± $12 (range, $0–$131) per case of varicella in children attending day care.

Hospitalizations and laboratory tests. Of the 200 day care varicella cases, 2 children with complications (1 with thrombocytopenic purpura and 1 with febrile convulsions) were hospitalized for 3 and 5 days, respectively. No laboratory tests or specific procedures were done on any of the other children, and none of their siblings with varicella required hospitalization. The actual charge for the 8 days of hospitalization for the 2 hospitalized children totaled $5490.

Total medical costs to society and to parents. The total medical cost to society of childhood varicella cases in the 193 families with at least 1 sick child was $14,860. This represented an average of $77 per family, including $34 for physician visits, $15 for medications, and $28 for hospitalizations. Most medical expenses were reimbursed to the parents. The average medical cost to parents of childhood varicella cases was $9 ($7 for physician visits and $2 for medications). There were no parental hospitalization costs because the parents of the 2 children hospitalized in this study had full coverage for hospitalization expenses through complementary health insurance.

Work days missed by healthy adults. In France, most parents of children attending day care are employed. (One of the priority criteria to have access to day care is that both parents work.) We found that 96% of children who developed varicella had working mothers, including 20% who worked part time. Similarly, at least 92% of fathers worked (information on the employment status of the father was not available for 11 families [6%] in which the parents were separated). In 101 (52%) of the 193 families with ≥1 case of childhood varicella, at least 1 parent or relative had to miss work an average of 4.5 ± 4.0 days (median, 4.0; range, 0.5–25). More mothers than fathers took time off work to look after the sick child (44% and 18%, respectively).

In 18 families (9%), ≥2 adults had to miss work. Mothers who stopped working to care for a sick child did so for a longer duration than did fathers (4.2 and 2.3 days, respectively). When considering all 193 families with at least 1 case of childhood varicella, parents or relatives missed a total of 452 days of work, corresponding to an average of 2.3 ± 3.7 days (median, 1.0) per family. The average duration of interruption of work was 1.9 and 0.4 days for mothers and fathers, respectively. Eighty percent of all work days missed (361/452) was attributable to the mothers. The corresponding costs per varicella case among children attending day care and per family are indicated in Table 2. Costs were obtained by multiplying each person’s number of work days missed by his or her net daily income. The average cost of work days missed for all families was $266 ± $423 (median, $78; range, $0–$2403) per family.

Extra baby-sitting. Extra baby-sitting was required in 97 (50%) of all families, for a total of 608 days, including 527 (87%) days free of charge. When required, extra baby-sitting lasted an average of 6.2 days. Almost all additional baby-sitting that was free of charge was provided by family members. Grandparents contributed highly and provided approximately two-thirds of the cost-free extra baby-sitting. Parents themselves provided another third, usually because they were on leave (sick leave or maternity leave), working part-time, or unemployed. Seventeen families had to pay for a total of 81 days of extra baby-sitting. The total cost was $1727.

Total non-medical costs to society and to parents. Total non-medical cost to society of childhood varicella cases in the 193 families was $52,990. This represented an average of $275
Table 2. Cost of work days missed in families of varicella-infected children between the ages of 3 months and 3 years who were attending day care centers in Lyon, France, between January and June 1995.

<table>
<thead>
<tr>
<th>Family member who missed work</th>
<th>Families with at least 1 missed work day</th>
<th>Cost to society (US $)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n/total</td>
<td>%</td>
</tr>
<tr>
<td>Mother</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost per case†</td>
<td>83/200</td>
<td>(42)</td>
</tr>
<tr>
<td>Cost per family‡</td>
<td>85/193</td>
<td>(44)</td>
</tr>
<tr>
<td>Father</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost per case†</td>
<td>32/200</td>
<td>(16)</td>
</tr>
<tr>
<td>Cost per family‡</td>
<td>34/193</td>
<td>(18)</td>
</tr>
<tr>
<td>Any relative (all adults)§</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost per case†</td>
<td>98/200</td>
<td>(49)</td>
</tr>
<tr>
<td>Cost per family‡</td>
<td>101/193</td>
<td>(52)</td>
</tr>
</tbody>
</table>

* By definition, median of observed values is 0 if >50% of subjects have no event.
† Includes only children attending day care.
‡ Includes costs for all cases of childhood varicella in family (i.e., child attending day care and siblings, whenever appropriate).
§ Comprises parents and other adult relatives who missed work to care for child with varicella.

per family with at least 1 sick child, including $266 for work days missed and $9 for extra baby-sitting. Most work days that were missed to care for a sick child corresponded either to sick-child leave offered by employers or to regular vacation days and did not cost the parents any money. Other types of work days missed cost parents an average of $71 per family. Costs related to extra baby-sitting had to be paid entirely by parents. The average non-medical cost to parents was $80 per family.

Intangible costs. Parents also mentioned that varicella caused disruption of family life. A major disruption was caused in families in which either an adult or a second child also developed varicella. During the study period, 9 adults developed varicella. Although none of them had complications or required hospitalization, 5 parents with varicella had to miss work, for a total of 43 days. Most varicella-infected children (78%) who attended day care had to miss day care an average of 1 week (7 ± 5 days). In 157 (81%) of the 193 families, a sick child stayed at home rather than attend day care or school. There was at least 1 sick child at home an average of 5.2 days per family. This posed important problems concerning baby-sitting for 20% of the families and professional or financial problems for another 20% of them.

About 25% of the families mentioned the necessity for major changes in their daily routine because of varicella, including isolation to prevent infection of others. Sleep disorders and fatigue were reported as the main disruption in 18% of families. Fear of varicella complications in children or of infection of history-negative adults was reported in 8% of the families, including 2 pregnant mothers who had to receive intravenous immune globulin. A few parents mentioned the inconvenience of vacation days lost and of traveling expenses for grandparents. Only 11 families (6%) reported few or no problems related to their child’s varicella infection. Also worth mentioning is the disruption of day care organization in those DCCs in which a high percentage of children had varicella.

Discussion

Country-specific data on the cost of varicella are essential for cost-effectiveness evaluation of vaccination programs. This study emphasizes the important social and medical costs of varicella in the day care setting. Children with varicella had an average of one physician visit and took three medications. In the 193 families with at least 1 case of childhood varicella, an average of 5.5 days was needed to care for sick children, including 2.3 days of work missed (usually by mothers) and 3.2 days of extra baby-sitting (usually provided by grandparents). The total cost (medical and non-medical) to society entailed by these episodes of childhood varicella was estimated to be $67,850. This corresponded to an average of $309 per varicella case in children attending day care and, when considering all cases of childhood varicella in the family, ~$352 per family with at least 1 sick child. Medical costs accounted for 22% of all expenses. After all reimbursements, the average total cost to parents was estimated to be $89 per family, including $80 of non-medical costs.

This study also emphasizes that the cost data observed in one country do not necessarily apply to other countries. Indeed, the impact of varicella in France seems to differ from that observed in the United States, as reported in two US studies [6, 9]. In our study, the rate of physician visits among children...
with varicella was 1.0 per varicella case, for both day care attendees and their older siblings. This rate is much higher than rates reported in the United States (0.3 [6] and 0.5 [9] visits per varicella case). The higher rate in France may be related to the young age of children with varicella in our study, although the frequency of physician visits did not seem to drop with increasing age of varicella cases. It is also likely that many physician visits in the United States are replaced by telephone calls to health care providers. Indeed, rates of telephone advice calls of 0.2 and 1.0 per varicella case were reported in the United States, as opposed to in France, where they are uncommon. The rate of physician visits may also be related to the availability of universal health care insurance in a particular country. For example, in a small Australian study, an average of 1.2 medical consultations per varicella case was reported [8]. In Germany, a rate of ~1.9 physician visits per varicella case (from a survey of 216 parents) was reported in a recently published cost-effectiveness evaluation of varicella vaccination [1].

The average number of medications administered to children with varicella in our study was high. Corresponding data from other countries are not readily available, although data provided in the most recent US study suggested that the use of medications in the United States was close to that in France [6]. The main difference was that medications were usually obtained by prescription in France, whereas in the US study, non-prescription medications predominated. The average cost of medications in France was $15 per family, including a $2 cost to parents compared with a cost to parents of $20 per family in the United States.

Medical costs, including hospitalizations, accounted for 22% of all varicella-related costs in our study population. This is much higher than anticipated in the first cost-effectiveness analysis done in the United States (in 1985), where medical costs were assumed to represent 5% of total costs [4]. However, the exact percentage attributable to medical costs has not been estimated from actual cost data in the United States. A similar proportion of ~5% of total costs was reported in Australia [8].

Exclusion of children from varicella school is recommended in France [14]. Exclusion policies were not strictly applied by all DCCs during the study, and we did not find that this greatly influenced the number of days of day care missed by children with varicella.

The average number of days of day care missed by children was approximately the same in our study as that reported in the United States (5.3 and 5.6 days, respectively) [6]. Nevertheless, the average number of work days missed per varicella case was slightly higher in our study (2 days) than in the United States (1.6 days) [6]. This result may be related to the fact that most mothers of French children attending day care are employed. In addition, to avoid missing work for too long, mothers may have kept work losses minimal. Indeed, an average of 2.6 and 1.0 work days missed per child with varicella was reported in Australian mothers and fathers, respectively [8]. German parents also seem to miss work longer than our French families (an average of 2.6 days per child) [1].

The mean cost of work days missed per varicella case was approximately the same in our study ($231 in 1995) as in the United States ($202 in 1993). In the United States, similar to the case in France, very few families had to pay for extra babysitting. Total medical and non-medical costs to parents were $89 per family in our study. Corresponding data from other countries are unavailable.

The main limitation of this study is that it was restricted to young children attending day care. This restriction may have led to an overestimation of both medical and non-medical costs of varicella because parents of young children may be more willing to seek medical care, especially if it is their first child, and because parents of children attending day care are more likely than other parents to work. Indeed, the number of children per family in the study (1.5 children under age 18) tended to be smaller than usual for French families (1.8 at the national level). Also, the percentage of families in which both parents worked was higher (88% of families with varicella cases compared with 51% at the national level). In addition, the income distribution of the study population was likely lower than that of other young parents because low income is a priority criterion for access to day care.

Thus, the study population was not representative of the general French population, and it is difficult to assess how this impacted the estimation of varicella costs. Caution should be taken in generalizing the results, as the costs estimated in our study may not apply to all childhood varicella cases in France. Extending the study to school-aged children would provide more thorough data on the costs of childhood varicella in France. Ideally, population-based cost estimates would be required for reliable cost-effectiveness evaluations to be obtained. Such data are presently unavailable in any country.

Varicella vaccine is not licensed for use in healthy children in France. Now that most eruptive diseases can be prevented by vaccination, varicella is the most common eruptive infectious disease of childhood in France. Universal vaccination has been shown to be cost-effective in the United States, where routine varicella immunization of healthy children is now recommended at 12–18 months of age [3, 15]. Since varicella is usually considered to be a benign childhood disease by physicians and health care authorities, most European countries are still reluctant to implement varicella vaccination programs. By providing data on the health impact and cost of varicella in children attending day care in France, this study constitutes useful information for decision makers.

Acknowledgments

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