# SCREENING FOR CONGENITAL DISLOCATION OF THE HIP IN INFANTS IN BRITISH COLUMBIA

by

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ABSTRACT

Congenital Dislocation of the Hip in infants is a topic of screening interest in British Columbia. When a case of Congenital Dislocation of the Hip is not diagnosed and treated in the neonatal period, the infant may later require surgical care. In British Columbia, 94% of surgical cases for Congenital Dislocation of the Hip come from unscreened communities which produce only 66% of the live births in the province.

A cost-minimization analysis of screening and conservative treatment versus no screening and surgery shows that the cost of surgical care is more than three times greater.

This thesis proposes that the province extend screening services to all Obstetrical Units in British Columbia and train physicians and nurses to do the screening. A suggestion is also made to incorporate hip screening into a comprehensive neonatal developmental screening package.

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# CHAPTER 1

# CONGENITAL DISLOCATION OF THE HIP IN INFANTS

## Objectives

Congenital Dislocation of the Hip (CDH) is the most common defect seen in newborn infants, comprising 75% of all congenital defects (1,2). It can be identified by a simple physical examination (3,4,5,6), and if identified early can be treated effectively in a conservative manner using triple diapers or a simple brace (4,5,7,8). Thus, CDH is an ideal condition to consider for large scale screening. Early, conservative treatment has been suggested to reduce the risk of idiopathic Osteoarthritis of the Hip related to CDH (34,35,36,37,38,39).

This thesis examines existing screening programs for CDH, the costs associated with screening, and considers the viability of extending infant hip screening to those areas of the province, accounting for about two-thirds of all births, where little or no CDH screening now exists.

## Definition of terms

Congenital Dislocation of the Hip, originally defined by Hippocrates in 400 B.C. (1), refers to a complex association of clinically defined characteristics of the hip, primarily in newborns, which may lead to a gradual upward displacement of the femoral head (2). A secondary reaction arising from muscle contracture further alters the weight bearing characteristics of the hip, and towards the end of the first year of life, impairs a child's ability to develop a normal gait (3,5).

Several terms are used interchangeably to describe CDH. In this thesis, the term dysplasia will be used to identify the whole range of degrees of severity of CDH. Dysplasia refers to a situation of primary instability of the hip in the newborn that can be identified by Barlow's test. This test is a physical manipulation of the head of the femur towards the posterior rim of the acetabulum. The degree of movement of the joint is dependent on the laxity of the ligaments in the joint.

At the mild end of the scale of dysplasias is subluxation. Subluxation refers to a situation where contact is maintained between the femoral head and the acetabulum, but the contact between the articular surfaces is not normal. The joint is not reduced, nor is it completely in place.

Frank dislocation means that the head of the femur is not in the acetabulum and the surfaces of the joint do not have any contact. This is the most severe degree of dysplasia. The term Congenital Dislocation of the Hip, used here, refers to the whole range of degrees of severity of dysplasia of the hip that can be identified by the accepted screening test.

When early detection of CDH leads to conservative treatment in the neonate, the hip defect can be corrected without surgical intervention (3,7,9,10).

Untreated, CDH may cause shortening of the leg associated with the dislocated hip, limping, and a limited range of movement of the hip. Total body distortion is not uncommon in severe cases.

## Etiology

Several characteristics are known to place an infant at risk for CDH. The incidence of CDH has been shown in many studies to be highest for infants with a Breech presentation (2,3,5,6,7,9, 11,17,26). The infant's hips, in this situation, are held in an unstable position 'in utero' since the thighs and knees are fully extended. In a Vertex presentation the baby's thighs are flexed and slightly abducted, providing a stable hip position.

Delivery of a baby with Breech presentation can also dislocate hips that were merely subluxed 'in utero'. Thus, it is recommended that abduction of the hips be maintained for at least several days after birth for these infants (2,8,11,12,16,35).

Studies of CDH in infants consistently show an incidence three to four times higher in females than in males (4,5,7,9,11). Von Rosen (11) has suggested that hormonal influences similar to the ones that cause laxity of the pelvic joints in the mother during the last weeks of pregnancy cause joint laxity in the infant, and that this effect is more likely in a female infant.

On the same basis as Von Rosen, Wynne-Davies (6), McKibbon (8), and Czeizel (10) suggest that laxity of the ligaments in the hip joint is a contributing factor in CDH. Two of these authors (6,10) suggest that ligamentous laxity may be related to a shallow acetabulum, but a causal relationship has not been established.

## Incidence Rates

Table 1.1 summarizes the incidence rates found in six major hospital studies of dysplasia of the hip in newborns.

Comparisons of these studies are difficult to make in absolute terms because different degrees of dysplasia are considered in each study, the populations differ in place and time, and one study compares different hospital districts (29).

TABLE 1.1

SUMMARY OF INCIDENCE RATES OF CDH

| Author and Date | Rate/1000 infants screened |
|---|---|
| Barlow,1962 (19) | 14.9/1000 |
| Von Rosen,1968 (11) | 1.7/1000 |
| Mitchell,1972 (33) | 10.6/1000 |
| Williamson,1972 (28) | 2.3/1000 |
| Artz,1975 (26) | 13.3/1000 |
| Jones,1977 (29) | 2.3/1000 |

Barlow, in Salford, England (19), examined 9,289 infants during their first week of life and found 159 abnormal hips in 139 babies. Dislocated hips occurred 81 times and unstable hips an additional 78. When both dislocated and unstable hips are included as CDH ( hip dysplasia) the incidence is 14.96 per 1000 births.

Von Rosen, in Malmo, Sweden, (11), examined infants in the city's one Obstetrical department where 99% of all infants in

Malmo are born. Each clinical diagnosis of CDH was verified by radiography, which likely the reason for the very low incidence. Radiography is only capable of identifying the most severe CDH, eliminating all other milder dysplasias from the numbers of positive diagnoses. In 24,000 examinations the incidence was 1.7 per 1000 infants.

Mitchell (33) conducted a study of CDH in infants in a large maternity hospital in Edinburgh, Scotland. A total of 31,961 infants were screened by Pediatricians and those infants with a positive test were checked by an Orthopedic Surgeon. The baby's hips were classified as 'luxated' if dislocation was diagnosed, and as 'unstable' if the joint was lax. In the study population 3 per 1000 births (100 infants) had luxated hips requiring a brace or splints. An additional 126 infants, or 3.9 per 1000 births had a diagnosis of unstable hips. The study also found 123 infants, 3.7 per 1000 births, who had unstable or luxated hips at birth that became stable before discharge. The total number of infants found with a positive test for dysplasia at screening was 10.6 per 1000 births.

In Belfast, Northern Ireland, Williamson (28) examined data collected in two maternity hospitals where the Ortolani test was used by a variety of different professionals. (The Ortolani test is similar to the Barlow test, but the examiner listens for the hip to 'clunk' as it dislocates.) Each positive case was followed by an Orthopedic Surgeon. One unit recorded 37 cases in 28,740 births or 1.3 per 1000, while the other had 42 cases in 6,100 births or 6.9 per 1000. The average incidence in the combined units in the study was 2.3 per 1000 births.

The Belfast study also identified the rate of diagnoses beyond the neonatal period as 0.2 per 1000 in the first unit, and 1.9 per 1000 in the second. This is the opposite of what would be expected.

Artz et al (26) examined the hips of newborns in the New York City Hospital. Of 28,424 births in seven and one-half years, 23,408 were examined. A total of 331 newborns were found with hip dysplasia: dislocated or dislocatable hips. The incidence rate of 13.3 per 1000 was based on 312 of these infants who were full term.

Jones (29) has described a five year series of 29,336 births in Norwich, England. Half of these births occurred in hospital, and half in the rural district including 5,448 born at home. Infants with hip dysplasia were referred to Orthopedic Surgeons. As in the Von Rosen study, confirmation of CDH was made using radiographs. This method of diagnosis is able to identify only the most severe cases of dysplasia, so fewer cases would be expected. Hospital doctors were shown to detect 2.3 cases per 1000 births, and rural doctors and midwives 1.3 per 1000 births.

Studies accepting a wide range of degrees of dysplasia had higher incidence rates of CDH than those studies using radiographs as a confirmation of dysplasia.

## Spontaneous Recovery

Spontaneous recovery refers to decreasing joint laxity in infants as they mature (19,26). The number of infants in a newborn population with identifiable dysplasia decreases with age (in days) of the infant.

Barlow (19) found this recovery rate to be 58% in his study; Bell and Tredwell (7) experienced a rate of 80% in their study; and Fredensborg and Nillson (27) found a spontaneous recovery rate of 90%. All three studies compared infants under one week of age with those older than one week.

These rates of recovery will affect the incidence rates found in screening programs for CDH depending on the age of the infants at the time of testing. Screening programs for neonates will have much higher incidence rates than programs for infants as much as four or five days older.

## The Screening Test and Conservative Treatment

The most widely accepted tests for CDH are Barlow's test (19) and the Ortolani 'click' (11). The screening physician or nurse gently adducts and abducts the infant's hips to determine the stability of the joint. If the head of the femur slips out of the acetabulum during the test, the infant is diagnosed as having CDH.

Early conservative treatment for CDH consists of gentle abduction of the hips with triple diapers. All infants with any degree of dysplasia are treated for an average of six weeks, and longer if the hips remain unstable (7,11,19).

For those cases of dysplasia that do not respond to triple diapers, a brace is prescribed. The brace places the baby's hips in more secure abduction (15,19,22), and it is easily removed to allow the mother to care for the infant. The average time an infant with CDH is braced is three months, the brace is well tolerated. The Orthotics departments of most hospitals

have the ability to construct these simple devices (3).

Treatment for 'Late' Cases

Infants with CDH who are identified after the neonatal period are termed 'late' cases. These children usually require surgical treatment to correct their disability (1,2,15,22,32). Bracing is not effective if initiated in infants over two months of age (35).

Surgical treatment consists of two weeks of body traction, followed by either open or closed reduction of the hip. In a closed reduction, the femoral head is manipulated into the acetabulum, frequently with the assistance of an adductor tenotomy. The child is then placed in a hip cast for 3 to 6 months, with regular cast changes at 6 week intervals.

Children who require an open reduction have surgical repair of the acetabulum, including a bone graft if necessary. The hip is usually pinned in place, and the child wears a cast for 6 weeks. At the end of this time, the child is rehospitalized for removal of the pin.

The outcome of surgical intervention in terms of hip function is considered to be less satisfactory than early conservative treatment with triple diapers or a brace (2,11,19). Surgery is invasive and places the child at risk for Anaesthetic death, infection, and the possibility of failure of the bone graft or malalignment of the bones. Late hip repair delays the potential for growth to promote stabilization of the hip joint as early as triple diapering does.

Bjerkreim (34) and Somerville (35) have suggested that there is a strong relationship between CDH in infancy and Osteoarthritis of the hip in middle life. This process has been linked to avascular necrosis due to the trauma of surgery (36).

## Criteria of a Useful Screening Program

Six common criteria have been selected to determine whether screening for CDH can be justified in British Columbia (46,47,48,49).

First, the condition of interest should be considered a health problem. It is known that CDH is the most commonly seen congenital defect (1,2), and if undetected and untreated will cause significant disability (18).

Second, the natural history of the disease should be understood. The significant risk factors for CDH cannot be altered: sex, genetic background, and birth presentation; eliminating the potential for primary prevention. Consequently, the optimal management of CDH is secondary prevention: early detection and treatment of the defect.

Third, in order to identify cases of the disease, the screening test should be reliable, acceptable to the person screened and have high predictive value. Both the modified Barlow's test (19) and the Ortolani 'click' test (11) fulfil the first two criteria. The predictability of the test has been shown to surpass 85% as Lehmann's study identified 6 cases per 1000 live births, while 0.06 cases per 1000 live births were missed by screening and required surgery later (23).

Fourth, effective treatment should be available for all cases. Early conservative treatment with triple diapers and, if necessary, a brace, has proved effective in many studies (3, 7,10).

Fifth, screening should be cost-effective. In Chapter 4 this thesis provides a cost-minimization analysis of screening and early treatment compared to surgical intervention.

Sixth, the screening test should be available for all persons at risk for the disease. Chapter 5 considers the viability of province-wide screening for CDH in infants.

## Summary

The value of infant screening lies in its potential to identify cases of CDH during the neonatal period when conservative treatment yields excellent results. Screening thus becomes a mechanism for dramatically reducing the need for surgical intervention by reducing the number of cases identified too late for the use of non-invasive techniques of management.

# CHAPTER 2

# SCREENING PROGRAMS IN BRITISH COLUMBIA

## Introduction

This chapter examines those CDH studies done in British Columbia in order to determine the incidence rates that could be expected from a province-wide screening program. The number of cases of CDH requiring surgery in an unscreened population are also identified.

## The Grace Hospital Study

Bell and Fraser (9) conducted a cohort study of risk factors in neonates diagnosed with CDH at Grace Hospital in Vancouver. One Orthopedic surgeon examined 16,008 infants during a five year period: January 1,1975 to December 31,1979. Data were collected on birth weight, sex, age in days at the time of examination, birth presentation, diagnosis of CDH, and hip involvement. Identification of ethnic origin (Oriental and other) was also made. To determine the effect of these variables (without examining all normal cases), all positive cases of CDH were placed into a case group (232 cases), and a computer-generated random number table was used to select the same number of infants from the group of 15,776 unaffected infants.

A follow-up time of 18 months was considered sufficient to discover the presence of any false-negative diagnoses among the screened infants.

The incidence of CDH in the Grace Hospital population of screened infants was 14.6 per 1000. An estimated 2.2% of live births were missed by screening.

In the Oriental group of 3201 infants screened, only 5 showed signs of CDH, an incidence of 1.5 per 1000. This low rate indicates a reasonable basis for further investigation. Bell and Fraser (9) showed that the only statistically significant difference between Oriental infants and others was birth weight, the Oriental infants weighed less.

The ratio of females to males was 3:1 and infants with CDH had Breech presentation 9 times more often than infants with normal hips.

No statistically difference was found between the cases and the cohort with respect to birth weight, season of birth, or age at time of examination. (Table 2.2 and 2.3, Appendix to this chapter.)

These risk factors have been identified in other studies (2,7,10,17,19,24,26) suggesting that screening at Grace Hospital is finding CDH at similar rates and with similar patterns of risk characteristics as other major studies.

## The Vancouver General Hospital Study

Bell and Tredwell (7) have summarized 9½ years of hip screening in 32,480 infants at the Vancouver General Hospital from March 1967 to the end of 1976. The authors estimated that 97% of all live births were screened.

The pattern of CDH cases at the Vancouver General Hospital was generally similar to that at Grace Hospital. The incidence of CDH in the screened population was 9.9 per 1000, the ratio of females to males was 4:1, and the relative risk associated with Breech presentation was 5:1 compared to Vertex presentation.

In Bell and Tredwell's experience (9) not all hip surgery can be eliminated. The false-negative rate in this series of examinations was 1 in 5000, a total of 6 children.

The St. Paul's Hospital Study

Lehmann compiled data on the hip screening program at St. Paul's Hospital for the years 1967 to 1971 (23). The study found an incidence rate of 6.0 per 1000 live births, but no details were presented on risk factors.

In addition, Lehmann reviews the incidence rates of CDH throughout the province. Although the data for this study were collected a decade ago, it remains the best comprehensive analysis of the screening situation in this province. Table 2.1 summarizes the rates identified over the study period. Cases of CDH in infants born in hospitals where screening was not systematic occurred in 1.2 per 1000 live births diagnosed neonatally, while 1.4 cases per 1000 live births were diagnosed after the neonatal period (1 month of age).

Lehmann (23) estimates that by 1981 about one-third of infants born in British Columbia received hip screening. In terms of geographical distribution, this one-third are resident in the Vancouver area. Lehmann recommends a screening program in all newborn nurseries in the province, co-ordinated by regional Orthopedic Surgeons, using either physicians or nurses to administer the test.

Conservative treatment of all cases of dysplasia is justified since no criteria are available to distinguish those cases for whom treatment is necessary, and those for whom it is not.

TABLE 2.1 IDENTIFICATION OF CDH IN B.C. HOSPITALS WITH NO SCREENING PROGRAM: 1967-1971 (23)

| HOSPITAL | NUMBER OF LIVE BIRTHS | NUMBER OF CDH'S PER 1000 LIVE-BIRTHS | |
|---|---|---|---|
| | | Neonatal Period | After 1 mo. |
| Grace,Vancouver | 13,121 | 0.7 | 1.2 |
| Royal Columbian, New Westminster | 8,724 | 3.6 | 1.7 |
| Royal Jubilee,Victoria | 8,251 | 0.7 | 1.6 |
| Lions Gate,Vancouver | 7,084 | 0.7 | 1.1 |
| Prince George Regional | 7,081 | 0.7 | 1.1 |
| Burnaby General | 6,969 | 3.2 | 1.4 |
| Royal Inland,Kamloops | 4,924 | 0.6 | 0.6 |
| St.Vincent's,Vancouver | 4,511 | 0.7 | 2.2 |
| Victoria General | 4,486 | 0.7 | 0.9 |
| Surrey Memorial | 4,472 | 0.0 | 1.6 |
| Richmond General | 4,191 | 0.9 | 2.4 |
| Nanaimo Regional General | 3,377 | 5.9 | 1.8 |
| Kelowna General | 3,178 | 0.3 | 1.3 |
| Chilliwack General | 2,702 | 0.0 | 0.7 |
| Trail Regional | 1,996 | 1.0 | 1.0 |
| Campbell River & District | 1,935 | 0.0 | 1.5 |
| Maple Ridge | 1,897 | 0.0 | 1.0 |
| Powell River General | 1,770 | 0.0 | 1.7 |
| Penticton General | 1,574 | 0.6 | 0.6 |
| Matsqui-Sumas-Abbotsford | 1,331 | 0.0 | 4.5 |
| TOTALS AND AVERAGES | 93,574 | 1.2 | 1.4 |

This treatment regimen also has the potential to reduce the risk of idiopathic Osteoarthritis of the Hip associated with the surgical correction of CDH. (23).

Summary

The incidence rates for CDH in newborns screened in British Columbia are: 6.0 per 1000 (23), 9.9 per 1000 (7), and 14.6 per 1000 (9). These reports provide a range of numbers of cases that would be found in a screening program.

Lehmann's study identifed less CDH per 1000 live births than did Tredwell and Bell (7), or Bell and Fraser (9). Lehmann (23) also missed more cases of CDH at screening which later required surgery. A higher rate of cases of CDH during the neonatal period may be considered to provide more effective screening since fewer cases of surgery will be required. Tredwell and Bell report no cases of surgery in their screened populations since 1975 (7).

The summary of rates of diagnoses in infants over 1 month of age from hospitals without screening (Table 21. (23)) offers a reasonable number (1.4 per 1000 live births) for calculating the cost of providing surgical care to unscreened populations. Dr. Tredwell suggests that 1.5 per 1000 live births will require surgical care if they are unscreened (personal communication from Dr. Tredwell, November,1981).

Appendix for Chapter 2

Results from the Grace Hospital Study

TABLE 2.2 EFFECT OF BIRTH PRESENTATION ON INCIDENCE (9)

% for each group and (numbers)

| presentation | +CDH | normal |
|---|---|---|
| Vertex | 74.1% (172) | 95.7% (222) |
| Breech | 19.0% ( 44) | 2.2% ( 5) |
| Caesarian (Vertex) | 3.9% ( 9) | 1.3% ( 3) |
| Caesarian (Breech) | 2.2% ( 5) | 0.9% ( 2) |
| | 100.0% (232) | 100.0% (232) |

TABLE 2.3 SEASONAL VARIATION IN THE NUMBER OF CASES (9)

% for each 3 month period and (number)

| season | +CDH | normal |
|---|---|---|
| winter | 22.8% (53) | 28.0% (65) |
| spring | 18.1% (42) | 22.8% (53) |
| summer | 33.6% (78) | 24.6% (57) |
| fall | 21.1% (49) | 24.6% (57) |
| | 100.0% (232) | 100.0% (232) |

$X^2 = 6.15$ $P = 0.20$

# CHAPTER 3

# THE SCOPE OF THE CDH PROBLEM IN BRITISH COLUMBIA

## Introduction

This chapter explores the outcomes of not screening for CDH in hospitals outside Vancouver. The number of children requiring surgery due to a late diagnosis of CDH are identified. These cases are then linked to their residence by community to determine the sources of surgical cases.

## Data Source

The Research Division of Hospital Programs in the Ministry of Health provided a summary of discharge diagnoses of CDH and the residence by community of each child who received hospital care. The name of the child was not available for this analysis. Two hospitals reported surgical discharges: Children's Hospital and the Vancouver General Hospital. The hospitals reporting a discharge diagnosis of CDH in neonates were: the Grace Hospital, St. Paul's Hospital, and the Vancouver General Hospital. In addition, the Medical Records Librarian of the Prince George Regional Hospital provided discharge data on treatment for CDH.

Tha data represents the most recent year available: fiscal 1979 (April 1,1979 to March 31, 1980). The discharge listings are in the Appendix to this chapter.

## Definition of Terms

A child may have one or more procedures listed with the discharge diagnosis of CDH. These procedures are called an

episode of care when they occur while the child is hospitalized during a distinct time period. When a series of episodes are linked together, as they are in the surgical treatment of CDH, the child receives what is termed a pattern of care. These patterns are distinct. A child receiving an open reduction of the hip can be differentiated from one receiving a closed reduction.

The patterns of care expected with each procedure were used to determine, from the hospital discharge listings, how many children received which treatment. As a result, it is possible to discover how many children were treated, not just the number of discharges attributable to CDH.

For example, the treatment pattern for a Ft. St. John infant included: traction, osteotomy, blood transfusion, removal of a hip pin, and physiotherapy. By identifying the age of the child at each discharge, the time lapse between procedures may be noted, confirming the linkage of each procedure with a particular case.

## Case Excluded from Analysis

An examination of the coded data indicates that one child who had a discharge diagnosis of CDH actually underwent a hernia repair. As a result of this apparent inaccuracy in the data, a coding error has been assumed, and this case has been withdrawn from the calculations.

Since only primary diagnosis was requested from the Research Division of Hospital Programs, cases of CDH associated with some other reason for hospitalization will not appear.

This kind of omission will underestimate the actual number of surgical cases in the province. For example, children handicapped with severe Cerebral Palsy tend to experience dislocated hips due to spasticity of the hip musculature. Surgical repair of these dislocated hips may occur, but the condition listed at discharge may be Cerebral Palsy.

## Number of Children Receiving Surgical Intervention

Analysis of the data presented in the Appendix of this chapter shows that 41 children received 61 episodes of care at Children's Hospital in fiscal 1979.

In addition, 4 children received surgical treatment for CDH at the Vancouver General Hospital, and 2 at the Prince George Regional Hospital. Thus, the provincial total for 1979 is 47 cases.

Of this total, only 3 children resided in Vancouver at the time they were treated. It is possible that they were not born in a Vancouver hospital, but this information was not available from Hospital Programs.

## Estimating the Rate of Surgical Cases

The incidence rate of cases of CDH presenting for surgery from an unscreened population has been estimated by Lehmann as 1.4 per 1000 live births (23). Tredwell suggests that 1.5 per 1000 unscreened infants will require surgery for CDH. Von Rosen (11) found 1.77 cases of CDH received surgery per 1000 unscreened infants in the Swedish population studied.

If the actual number of cases (47 children) identified in the analysis of data from Hospital Programs is divided by the number of births in British Columbia for 1979 (38,639 live births) the incidence rate for surgical cases from the unscreened two-thirds of the province (25,537 live births) is 1.84 per 1000. This assumes that the three babies residing in Vancouver at the time of CDH surgery were not born in Vancouver. If these three infants are presumed to have been born in Vancouver, the surgical rate for the unscreened two-thirds of the province drops to 1.72 per 1000 live births, a rate close to Von Rosen's (11) finding, and only 0.32 cases per 1000 higher than Lehmann's figure (23).

Summary

This chapter has shown that two-thirds of the live births in the province are producing 94% of the surgical cases of CDH.

The actual rate of cases (1.72 per 1000 live births) is higher than the estimate of 1.4 per 1000 (23). The cost-minimization analysis will be based on 1.5 cases per 1000 live births, acknowledging that this figure may be an underestimate of the actual rate, but a reasonable approximation.

Appendix for Chapter 3

Data from the Research Division of Hospital Programs, Ministry of Health, Fiscal 1979 (April 1, 1979 to March 31,1980)

and Data from the Prince George Regional Hospital, 1981

CASES DISCHARGED FROM SPECIFIED BRITISH COLUMBIA HOSPITALS
WITH DIAGNOSIS OF CONGENITAL DISLOCATION OF HIP (ICD9 CODE 754.3)
APRIL 1, 1979 TO MARCH 31, 1980

| Hospital | Age | Male | Female | Total |
|---|---|---|---|---|
| Vancouver General | livebirth | 6 | 17 | 23 |
| | 1 day | 1 | 1 | 2 |
| | 1 mo. | - | 1 | 1 |
| | 3 mo. | 1 | - | 1 |
| | 6 mo. | - | 1 | 1 |
| | 2 yr. | 1 | - | 1 |
| Total | | 9 | 20 | 29 |
| St. Paul's | livebirth | 2 | 3 | 5 |
| Grace | livebirth | 13 | 29 | 42 |

Children's

| Residence | Age | Sex | Surgical Procedure |
|---|---|---|---|
| Abbotsford | 1 yr. | F | 03.16 |
| Burnaby | 9 mo. | F | 11.12 |
| " | 1 mo. | F | 91.74 |
| " | 6 mo. | F | 95.12, 91.74 |
| " | 3 mo. | F | 07.29, 07.53 |
| " | 6 mo. | F | 11.12 |
| " | 3 mo. | F | 11.12 |
| " | 1 yr. | M | 95.15, 07.51 |
| " | 9 mo. | F | 65.01, 66.00 |
| Chilliwack | 1 yr. | M | 03.39, 11.88, 07.39 |
| " | 1 mo. | F | 95.12, 07.51 |
| Cranbrook | 4 yr. | F | - |
| " | 5 yr. | F | 07.29 |
| Delta | 3 mo. | F | 91.74, 95.76 |
| Fort St. John | 1 yr. | F | 07.29 |
| " | 2 yr. | M | 91.74, 07.51 |
| " | 2 yr. | F | 89.34, 13.03 |
| " | 2 yr. | F | 90.64, 07.39 |
| " | 2 yr. | M | 07.51 |
| Kamloops | 6 mo. | F | 92.24, 92.74, 03.16 |
| Langley | 1 yr. | F | 89.34 |

Cases Discharged . . . Congenital Dislocation of Hip (continued)

Children's

| Residence | Age | Sex | Surgical Procedures |
|---|---|---|---|
| Langley | 1 yr. | F | 89.34 |
| " | 2 yr. | M | 91.84, 89.34 |
| " | 3 mo. | F | 91.74, 95.12 |
| " | 3 mo. | F | 11.12 |
| Mackenzie | 5 yr. | F | 91.74, 07.44, 07.39 |
| " | 6 yr. | F | - |
| Matsqui | 3 yr. | F | 91.84 |
| New Westminster | 1 yr. | F | 91.84, 89.38, 95.76 |
| " | 1 yr. | F | 11.88 |
| North Vancouver | 1 yr. | F | 89.34, 95.76 |
| Port Clements | 1 mo. | F | 92.74, 11.12 |
| Powell River | 6 mo. | F | 95.12, 07.53 |
| Queen Charlotte | 7 days | M | 91.74, 07.53 |
| " | 3 mo. | F | 07.54 |
| Quesnel | 5 yr. | F | 89.34 |
| Richmond | 9 mo. | F | 91.74, 95.76, 03.16 |
| " | 9 mo. | F | 95.76, 07.29, 91.84 |
| Rossland | 1 yr. | F | 91.74, 95.12 |
| " | 1 yr. | F | 11.12 |
| Saanich | 6 yr. | F | 89.34 |
| Squamish | 3 mo. | F | 91.74, 95.76 |
| " | 6 mo. | F | 03.39, 07.53 |
| Surrey | 2 yr. | M | 95.14, 18.14 |
| " | 3 yr. | F | 89.38 |
| Terrace | 1 yr. | F | 89.34, 90.64 |
| Vancouver | 3 mo. | F | 95.12, 07.53 |
| " | 1 yr. | F | 92.84 |
| " | 3 mo. | M | 91.84 |
| Victoria | 6 yr. | F | 89.34 |
| West Vancouver | 6 mo. | F | 91.74, 95.12, 07.53 |
| Williams Lake | 1 yr. | F | 03.39 |
| " | 1 yr. | F | 91.74, 07.44 |
| " | 1 yr. | F | 11.13 |
| from another country | 1 yr. | F | 07.29 |
| " | 1 yr. | F | 89.34, 90.64 |
| " | 2 yr. | F | 90.54, 07.39 |
| " | 6 mo. | F | 91.74 |
| " | 9 mo. | F | 07.29 07.53 |
| " | 9 mo. | F | 07.51 |
| " | 2 yr. | F | - |
| Total - 53 | | F | |
| - 8 | | M | |
| 61 | | | |

CODING OF HOSPITAL DISCHARGE DIAGNOSES ICD9.

03.16 electroencephalogram

03.39 nonoperative measurements and examinations

07.29 forcible correction of a deformity

07.39 other physical therapy

07.44 other skeletal traction

07.51 application of a plaster jacket

07.53 application of a cast

07.54 application of a splint

11.12 replacement of a cast on a lower limb

11.88 removal of a cast

13.03 transfusion of whole blood

18.14 presacral sympathectomy

65.01 hernia repair

66.00 incision of the abdominal wall

89.34 division of the bone of the hip (osteotomy)

89.38 division of the bones of the pelvis

90.64 removal of an interanl fixation device

91.64 debridement of the femur

91.74 closed reduction of dislocation of the hip

91.84 open reduction of dislocation of the hip

92.24 division of joint capsule of the hip

92.74 contrast arthrogram of the hip

95.12 adductor tenotomy

95.14 myotomy for division (division of muscle)

95.76 other change in length of muscle, tendon, and fascia

Prince George Regional Hospital

Congenital Dislocation of the Hip, Semi-annual diagnosis index.

prepared by: Mrs. Carol Rother, C.C.H.R.A.(A)
Supervisor, Technical Services
Medical Records Department

NUMBER OF CASES OF CONGENITAL DISLOCATION OF THE HIP 1974-1979.

| Year | Number cases | Surgical cases | Age group: Newborns | 1-12mo. | 13-24mo. |
|---|---|---|---|---|---|
| 1974 | 3 | 2 | 1 | 1 | 1 |
| 1975 | 4 | 1 | 2 | 2 | - |
| 1976 | 2 | - | - | 2 | - |
| 1977 | 2 | 1 | 1 | - | 1 |
| 1978 | 9 | 4 | 1 | 3 | 2 |
| 1979 | 5 | 2 | 3 | 1 | 1 |
| Total: | 25 | 10 | 8 | 9 | 5 |

# CHAPTER 4

# A COST-MINIMIZATION ANALYSIS OF SCREENING FOR CONGENITAL DISLOCATION OF THE HIP IN NEWBORNS

## Introduction

This chapter addresses the issue of whether a screening program for CDH is cost-minimizing when compared to surgical correction of CDH in cases from an unscreened population.

## Cost-effectiveness Theory: the case of cost-minimization

Cost-effectiveness analysis provides a framework for comparing two methods of treating infants with CDH. In this evaluation, the outcomes of both methods of treatment are assumed to be the same: normal functioning of the affected hip joint. When the outcomes of two programs are the same, a special case of cost-effectiveness can be used, cost-minimization analysis.

In addition to the positive benefits of improved hip function, some negative psychological outcomes of both treatments can be considered. These may include the pain and suffering of the infant being treated, inconvenience and stress for the family members, the parental concern of having a child labelled congenitally defective, and the effect of residual disability in the child.

The objective of this analysis is to provide quantitative information on the costs of the alternative programs so that it becomes possible to choose the least costly program, assuming equally beneficial outcomes (43). The resources consumed (costs)

in both CDH programs, with the exception of psychological costs, are accounted for in dollar terms, which are not discounted.

## Statement of Program Objectives

In clinical terms, the objective of each program is to produce a normally functioning hip joint in an infant with a Congenital Dislocation. The screening program must find and treat, while the surgical program treats only those cases presented.

The sum of the outputs of each program is the number of children with CDH who are effectively treated. It is also necessary to be able to state with confidence whether all the children who could benefit from the program actually receive care. In other words, is the screening program finding all cases of CDH, or is surgery being provided for all 'late' cases?

## The Program Options and Data Sources

Two options will be compared. First, a comprehensive screening program such as that at Grace Hospital (9) or at the Vancouver General Hospital (7) will form the data base for determining the costs of a screening program. The incidence rates from these two hospitals are used to determine the likely range of the number of infants who would receive conservative treatment. The cost of treatment is included in the screening program total cost.

Second, a situation of no or ineffective screening will be used to estimate the surgical cost of hip repair in children with CDH. The data used were supplied by the Research Division of Hospital Programs (analysis in Chapter 3), and by Dr. Tredwell

of the Orthopedic Division of the Department of Surgery at Children's Hospital.

The British Columbia Medical Association Statement of Fees for 1981 is the source of data for the charges levied by Orthopedic Surgeons and Anaesthetists. The Registered Nurses Association of B.C. supplied the 1981 salary schedule for nurses. Dr. Tredwell outlined the patterns of care resulting from screened cases and from surgical cases. Dr. Blair Fulton, from the Department of Anaesthesia at the Vancouver General Hospital, described the anaesthetic procedures and protocol of patient care for young children. He also outlined some of the non-monetary costs a child may face in a surgical setting. These are: risk of anaesthetic death, risk of malalignment or non-union of bones or bone grafts, and risk of infections and complications.

Direct and Indirect Costs: definitions

This analysis will take into account each component common to the two programs, as well as those which are unique. There are some direct and indirect costs to be considered which vary across programs.

Direct costs for the health system include costs generated by screening, follow-up treatment, surgery, and associated hospital and physician costs. Direct costs to the family include braces for conservative treatment of CDH, and travel costs for those families whose child requires surgery. Due to the variability of these travel costs, they are acknowledged but not calculated.

Indirect costs are incurred by the families of children

requiring surgical care, and are made up of lost wages and lost productivity due to time away from work while travelling to Children's Hospital. These costs are also acknowledged but not calculated.

There is no lost productivity attributable to hip screening done in the Obstetrical Unit of a hospital, nor to the initial treatment of a positive case: use of a triple diaper. Minimal indirect costs may arise due to time spent for follow-up in the doctor's office.

Screening Program and Follow-up Treatment Costs

Screening costs at Grace Hospital and the Vancouver General Hospital are comprised of one half-hour of the screener's time twice weekly in the infant nursery. The Orthopedic Surgeons who perform the screening do not actually 'charge' for this service, but the cost of their time can be estimated at $50.00 for each half hour. (Dr. Tredwell's estimate) In addition, a member of the nursery staff must be available to record the results of the screening. An estimate of this cost is $7.00 for each half hour session, during which an average of 30 infants are screened.

It should be noted that Grace Hospital and the Vancouver General Hospital benefit from economies of scale which may not apply to other regional hospitals.

The incidence of positive cases of CDH at Grace Hospital is 14.6 per 1000 infants screened (9), and at the Vancouver General Hospital the incidence is 9.9 per 1000 live births (7). In this analysis 9.9 has been rounded up to 10.0. Of those infants identified by screening and treated with triple diapers, 80% will undergo recovery by the time of the first office visit

to the Orthopedic Surgeon. It is recommended that these babies continue to wear triple diapers until six weeks of age. For the remaining 20% a brace will be prescribed. The brace cost varies from $30.00 to $60.00 depending on the degree of immobilization required. The brace is paid for by the parent.

Using the data from the 1981 Fee Schedule (see the Appendix for this chapter) the screening and follow-up treatment costs are calculated and summarized in Tables 4.1, 4.2, 4.3, and 4.4.

The range of costs expected from screening and conservative treatment of newborns with CDH is $3286.00 to $3819.00 per 1000 infants entering the program.

Surgical Program Costs

Two types of treatment are used for correcting the mechanical deficiencies of CDH identified when the child is older than one month of age. The first is open reduction of the hip, used in about 40% of surgical cases. The second is closed reduction, used for the remaining 60%. (These estimates were made by Dr. Tredwell.) Both surgical procedure costs are analysed in detail in the Appendix to this chapter.

The per diem has been used in this analysis to approximate the cost of hospitalization and surgery for children requiring treatment for CDH. By presuming to err on the conservative side of any estimate of cost, this analysis will underestimate rather than overestimate the cost of the surgical program. The per diem includes operating room costs, post-anaesthetic recovery room costs, ward nursing costs, 'hotel components' such as food and laundry, overhead, and activities such as teaching and research.

TABLE 4.1

SUMMARY OF SCREENING COSTS AT GRACE HOSPITAL

| | | |
|---|---|---|
| Doctor's 'cost' to screen 3000 infants per year | 1 hr/wk x 52 wks x $100 | ...$5200 |
| Nursing time for 1 year | 1 hr/wk x 52 wks x $14 | ... $728 |
| Total annual cost | | ...$5928 |
| Cost per 1000 infants screened | | ...$1976 |

TABLE 4.2

SUMMARY OF TREATMENT COSTS FOR SCREENED INFANTS WITH CDH

| | | |
|---|---|---|
| Office visits for each CDH case occur when the child is: | 2 weeks old | ... $50 |
| | 3 months | ... $24 |
| | 6 months | ... $24 |
| | 12 months | ... $24 |
| Total office cost per CDH case: | | ...$122 |
| Cost of 10 cases per 1000 live births | | ..$1220 |
| Cost of 14.6 cases per 1000 infants screened | | ..$1708 |

TABLE 4.3

BRACING COSTS

| | |
|---|---|
| Brace cost: | ...$30 to $60 |
| Average cost of bracing 20% at incidence levels 10/1000 | ...$90 |
| Average cost of bracing 20% at incidence levels 14.6/1000 | .$135 |

TABLE 4.4

TOTAL SCREENING PROGRAM AND TREATMENT COSTS

| | 10/1000 live births | 14.6/1000 infants screened |
|---|---|---|
| Screening | $1976 | $1976 |
| Office visits | $1220 | $1708 |
| Braces | $ 90 | $ 135 |
| Total costs: | $3286 | $3819 |

Summary

The range of costs generated by a program that screens for CDH and treats all positive cases is $3286 to $3819 per 1000 infants entering the program.

Almost all surgery for CDH is done at Children's Hospital where the per diem is $373.85 (1981). The Children's Hospital per diem is high compared to the per diem of regional and general hospitals in the province. The average 1981 per diem was not available from Hospital Programs. If hip surgery for children was provided at a regional hospital the total cost of care would be lower. Since all but 5 cases of CDH surgery for the 1979 fiscal year used in this study were treated at Children's Hospital, the use of the actual per diem (373.85) is a good approximation of the real dollar cost.

Based on the detailed cost analysis in the Appendix to this chapter, Table 4.5 summarizes the relative contribution of each type of surgery to the average cost of treating one infant with a late diagnosis of CDH.

TABLE 4.5

TOTAL AND AVERAGE COSTS OF SURGICAL CARE

FOR 1000 UNSCREENED INFANTS

| | |
|---|---|
| Cost of closed reduction of CDH | $ 8,631.29 |
| Cost of open reduction of CDH | $10,393.15 |

Average cost = 60% ($8,631.29) + 40% ($10,393.15)

= $9,336.03 per child treated

Total cost per 1000 infants unscreened

= ($9,336.03 x 1.5 cases per 1000)

= $14,004.05 per 1000

## Summary

This analysis of surgical costs has shown that in a population of unscreened infants, 1.5 per 1000 live births will require surgery at a cost of $14,004.05.

## Sensitivity Analysis

The cost of screening and treating 1000 infants with an incidence rate of 14.6 per 1000 infants screened is $3,819.00. If a hospital did not experience the economies of scale described for Grace Hospital or the Vancouver General Hospital, the screening costs could rise, while the treatment costs remained constant.

If a health professional other than an Orthopedic Surgeon performed the screening test, the hourly screening cost would be reduced, lowering the screening cost. If the screening program used the most expensive screeners but provided the test to only half as many infants per hour, the total screening cost per 1000 infants would rise to $3,952.00. If nursery staff performed the screening test, the cost of screening 1000 infants would drop to $485.33, assuming that the yield was the same as that of an Orhtopedic Surgeon.

The broadest conceivable range of screening costs are therefore $485.33 to $3,952.00.

## Projected Annual Costs and Savings

If the screening program costs are projected onto a population of 35,000 newborns, the annual cost that could be anticipated would be $145,320.00. The surgical cost of treating

the same number of infants left unscreened would be $490,170.00 for one year. The savings attributable to a province-wide screening program would be $344,850.00. The major portion of this saving will occur due to a reduction in hospitalization of children requiring surgery for CDH.

## Conclusions

This cost-minimization analysis has shown that the cost of providing surgery to 1000 unscreened infants is three times higher than the cost of providing screening and conservative treatment to 1000 infants. In terms of its cost-minimization, a screening program for CDH in newborns is well justified in British Columbia.

Appendix for Chapter 4

Exerpts from the 1981 Fee Schedule

Detailed Calculation of Surgical Costs for CDH

Calculation of Costs

1. Open reduction of the hip in a child under 1 year of age.

This set of costs have been broken down into each phase of treatment the child receives. The per diem at Children's Hospital is $373.85 as of the 1981 fiscal year.

a) the child spends 14 days as an inpatient in skeletal traction.
- hospital costs: 14 x 373.85 . . . . . $ 5,233.90
- doctor's visits: 14 x 12.00 . . . . . $ 168.00

b) the child undergoes surgery for CDH.
- surgeon's fee: . . . . . $ 500.00
- anaesthetic: . . . . . $ 134.00

c) the child spends 5 days post-operatively as an inpatient
- hospital costs: 5 x 373.85 . . . . . $ 1,869.00
- doctor's visits: 5 x 12.00 . . . . . $ 60.00

d) 8 weeks after first admission, the child returns to hospital to have the cast and hip pin removed.
- surgeon's fee: . . . . . $ 80.00
- anaesthetic: . . . . . $ 53.60

e) the child remains in hospital 4 days.
- hospital costs: 4 x 373.85 . . . . . $ 1,495.40
- doctor's visits: 4 x 12.00 . . . . . $ 48.00

f) the child is followed by the doctor until the child is fully mature.
- yearly office visits:
15 x 50.00 . . . . . $ 750.00

Total costs . . . . . $10,393.15

Calculation of Costs

2. Closed reduction of the hip in a child under 1 year of age.

This set of costs is treated as in item #1.

a) the child spends 14 days as an inpatient in skeletal traction.

| | | |
|---|---|---|
| - hospital costs: | 14 x 373.85 | $5,233.90 |
| - doctor's visits: | 14 x 12.00 | $ 168.00 |

b) the child undergoes a closed reduction most often with an adductor tenotomy.

| | | |
|---|---|---|
| - surgeon's fee: | closed reduction | $ 180.00 |
| | adductor tenotomy | $ 127.00 |
| - anaesthetic: | | $ 53.60 |

c) the child spends 3 days post-operatively as an inpatient.

| | | |
|---|---|---|
| - hospital costs: | 3 x 373.85 | $1,121.55 |
| - doctor's visits: | 3 x 12.00 | $ 36.00 |

d) the child has an average of 4 cast changes via the Day Care Surgery*.

| | | |
|---|---|---|
| - hospital costs: | 4 x 126.61 | $ 506.44 |
| - surgeon's fee for casts: | 4 x 60.00 | $ 240.00 |
| - anaesthetic: | 4 x 53.70 | $ 214.80 |

e) the child is discharged the same day.

f) the child is followed by the doctor until the child is fully mature.

| | | |
|---|---|---|
| - yearly office visits: | 15 x 50.00 | $ 750.00 |

Total costs . . . . . $8,631.29

*The cost of Day Care Surgery has been estimated by Evans to be approximately one-third that of the hospital per diem. (49)

Data from the 1981 Fee Schedule of the British Columbia Medical Association

Fees for Orthopedic Surgery and Office Visits:

| | |
|---|---|
| Consultation | $50.00 |
| Repeat consultation for the same condition within 6 months | $24.00 |
| Continuing care by physician: | |
| office visit | $16.00 |
| hospital visit | $12.00 |
| home visit | $30.00 |
| emergency | $60.00 |
| CDH: closed reduction | $180.00 |
| open reduction | $500.00 |
| Adductor tenotomy: one tendon | $127.00 |
| two tendons | $212.00 |
| Bilateral cast change | $60.00 |

Anaesthetic Fees

The basic Anaesthetic unit charge for 1981 is $8.40. This unit charge is applied to each patient's care in four separate components:

a) The patient's history is evaluated by the Anaesthetist to determine the risk that the patient presents for the anaesthetic procedure. This is a 3 unit charge, or
3 x $8.40 . . . . . .$ 25.20

b) A loading item is identified for every surgical procedure (from 1 to 17) depending on the anaesthetic difficulty of the procedure. For an open reduction of the hip, the loading item is 4, so the total cost of this component is
4 x $8.40 . . . . . .$ 33.60

c) A time charge is used based on four components in each of the first two hours of an anaesthetic and six components in each subsequent hour until the surgery is completed. An open reduction in a child takes about two hours, so the time charge becomes
8 x $8.40 . . . . . .$ 67.20

d) A unit adjustment is made for the degree of expertise required for special classifications of patients. For newborns, an additional 5 units are billed, for children under one year or age, one additional unit is billed. Most open reductions are done on children of one year or less. The unit cost is . . . . . .$ 8.40

Average Anaesthetic cost for open reduction of CDH. . . . .$134.40

Average Anaesthetic cost for closed reduction of CDH. . . .$ 53.60

# CHAPTER 5

# PLANNING A PROVINCIAL SCREENING PROGRAM FOR CDH

## Introduction

To implement a provincial hip screening service for neonates, several conditions will need to be met. These conditions are discussed in this chapter, based on what is already known about CDH, the outcomes of existing screening programs and the cost implications of alternative ways of developing comprehensive screening services.

The optimal outcome will be the promotion of early conservative management of CDH with subsequent reduction of the number of cases of surgery.

## The Rationale for a Provincial Screening Program

The factors placing infants at risk for CDH have been identified (2,7,9,17,19,24,26). However, the natural history of the disease is not well enough understood to identify which infants with hip dysplasia at birth will benefit from conservative treatment and which will spontaneously recover hip stability (4, 23). Thus, all infants with a positive Barlow's test at screening should be treated with triple diapers.

The methodology for a comprehensive screening program is known (7,9,11,26) and can be applied in any newborn nursery in the province. Infants screened, and found to demonstrate signs of hip dysplasia should be treated with triple diapers, and followed by a physician.

Recommendations for repeat screening at two to four months

of age have been made (4,23). Parkin has suggested a two phase screening program with neonatal screening followed by a repeat test a few weeks after birth. However, he acknowledges that the value of the later test is questionable (4).

Frankenburg (48) suggests that the main barrier to CDH screening and early treatment has been that a screening program has not been shown to cost less than later surgical management of established cases of CDH. The cost-minimization analysis presented in this thesis suggests that CDH screening coupled with conservative treatment costs about one-third as much as surgical intervention in established cases.

Hip screening at the three Vancouver hospitals has sharply reduced the need for surgery of the hip in children born and examined for CDH in this city.

## Economic and Social Outcomes of Screening

Not all outcomes of a hip screening program can be identified as economic in nature. A net dollar saving will occur as more infants are screened throughout the province. In addition, there will be a reduction of morbidity and disability associated with hip surgery. The psychological trauma of hospitalization for young children will be reduced. The direct cost borne by families who must travel to Children's Hospital for their child's surgery will be eliminated, as will the indirect costs of income foregone due to lost work days.

In addition, there is growing concern among clinicians about the relationship between surgical intervention in CDH and idiopathic Osteoarthritis of the Hip (23,35,36,37,38).

A reduction in the amount of surgery performed now may well show a reduction in the incidence of this chronic disease in these children, thus creating possible additional health care savings in the future.

## Policy

A policy of universal services for newborns throughout the province would provide guidelines for provision of CDH screening in regions where this service is needed.

The decision-making power lies primarily within the Ministry of Health. If the screening was attached to a comprehensive neonatal developmental assessment it would have a lower marginal cost and an increased liklihood of implementation.

## Planning and Implementation

The planning will encompass the screening program, the facilities for treatment of positive cases, and evaluation of the program. First, interested health professionals will need to be found who will undertake hip screening. Second, physicians will be needed to provide follow-up care for positive cases, and a referral to Orthopedic Surgeons in regional centres will need to be considered. Third, facilities for making and fitting the braces needed for some CDH cases will be needed in hospitals without Orthotics Departments. A Physiotherapy Department is an adequate substitute where necessary, as has happened at the Prince George Regional Hospital.

## Staffing

Physicians and nurses with no previous experience at hip screening would require a short training period and some supervised practise to develop effective screening skills. Consideration is needed for additional administrative time in recording test results, managing the data, following missed infants, and referral of positive cases for treatment by physicians. The program should begin implementation in hospitals where an Orthopedic Surgeon is already in practise, and progress incrementally to other hospitals in each region.

If nurses are used as screeners, instead of Orthopedic Surgeons or Family Physicians, the relative cost of screening will decrease, increasing the cost-minimization effect of screening. However, the rate of identification of positive cases has been shown to decrease when residents were used to screen (23); no data are available on the effectiveness of nurses. Lehmann (23) recommends the use of an Orthopedic Surgeon where possible, because the rate of identification of positive cases is high, and the number of missed cases is lower than both residents and Family Physicians.

## Evaluation

Evaluation of the Provincial Screening Program will require records to be kept on the outcome of each screening test. In addition, the follow-up of positive cases will identify the number of infants who experience spontaneous recovery, and the number requiring bracing services.

Any cases presenting for surgery after the initiation of the screening program should be traced to their hospital of birth for confirmation of screening diagnosis. The Vancouver General Hospital study has shown that 1 in 5000 newborns screened will have no signs of Dysplasia but will require hip surgery during the first year of life. The program evaluation will show if this rate, projected on an annual birth rate of approximately 40,000 will produce 8 cases of hip surgery.

## Budget Implications

There will be an initial cost for the screening program to train screening personnel and provide additional record-keeping facilities.

However, there will be a more than compensating saving due to reduced numbers of surgical cases. The cost of providing surgical care to 47 cases in fiscal 1979 is estimated to be $490,170. If only 8 infants required surgery, the annual cost to the Ministry of Health would be (at $9,336. per child) $74,688. The saving is $415,482.

## Conclusions

This thesis has shown that it is possible to identify infants at risk for Congenital Dislocation of the Hip, and to treat effectively those found at screening to have dislocated or dislocatable hips. Screening and conservative treatment has been shown to cost only one-third as much as surgical care per 1000 live births. Some of the saving in surgical costs is consumed by screening and treatment costs.

Regions of the province have been identified where hip

screening is not done or is ineffective. These regions should receive priority in establishing new hip screening programs in neonatal nurseries.

Implementation of a province wide screening program for Congenital Dislocation of the Hip in infants has been supported by the data analysis and proposals made in this thesis.

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