Appendix J

Effectiveness of Well= Child Care and Cost-Effectiveness of Childhood Immunization

As a supplement to the discussion of well-child care in chapter **6, this** appendix presents nine tables summarizing studies of the effectiveness of well-child care and the cost-effectiveness of childhood immunizations. The first five tables summarize various types of studies of the effectiveness of well-child care as a whole:

- studies of varying the frequency of child health supervision visits,
- studies of comprehensive care programs,
- studies of Medicaid's Early and Periodic Screening, Diagnosis, and Treatment (EPSDT) program,
- studies of health outcomes in alternative health delivery and insurance systems, and
- studies of the effects of well-child care on developmental outcomes.

Three subsequent tables summarize studies examining the effectiveness of three specific components of well-child" care:

- the physical examination,
- the Denver Developmental Screening Test (DDST), and
- anticipatory guidance for child safety restraint use.

The last table is a summary of the studies evaluating the cost-effect iveness of childhood vaccination programs.

Table J-1.– Effectiveness of Well-Child Care as a Whole: Studies of Varying the Frequency of Well-Child Care Visits

Author	Years data collected	Study population	Study design	Sample size	Intervention	Outcome measures	Results	Comments
Gilbert, et al 1984[a]	1979-80	Ontario, low risk	RCT	214 experimental 252 control	Decrease the number of well-child visit from 10 to 5 in first 2 years	Number of physical abnormalities Number of undetected abnormalities Bayley HOME Maternal anxiety Satisfaction with care	**No differences detected**	**Small difference in actual number of well-child visits—6 19 in experimental group and 7.89 in control**
Hoekelman 1975[b]	1971-72	Rochester, low biologic risk–clinic and private	RCT	125 experimental 121 control	Decrease number of well-child visits from 6 to 3 in first year	Knowledge Satisfaction with care Compliance Utilization Number of undetected abnormalities	No differences detected	1 Extra visits occurred due to contact with nurses [c]Extra visits scheduled for experimental clinic patients 2 Inadequate measures of developmental/behavioral outcomes 3 Inadequate power for 50% difference in frequency of physical abnormalities 4 Outcome assessment not blinded to study group

Abbreviations RCT – randomized clinical trial; HOME = tests of cognitive development in the home

[a] R Gilbert, W Feldman, L Seigal, et al., "How Many Well-Baby Visits Are Necessary in the First 2 Years of Life?" **Can Med** *Assn J* **130857-881,** 1984

[b] R A. Hoekelman, "What Constitutes Adequate Well-Baby Care," *Pediatrics* 55:313-325,1975

[c] This sample for this study came from two sources. a private practice and a clinic. Those clinic patients who were randomized to receive a lower frequency Of well. child visits were nonetheless sc hedu led for additional ill and well-child (Immunization only) visits by the nurses or physicians of the clinic

SOURCE Off Ice of Technology Assessment, 1988, based on a background paper by C J Homer, ' Evaluation of the Evidence on the Effectiveness of Well-Child Care Services for Child ren, " prepared for the Off Ice of Technology Assessment, U S Congress, Washington, DC, April 1987

Table J-2.—Effectiveness of Well-Child Care as a Whole: Studies of Comprehensive Care Programs

Author	Years data collected	Study population	Study design	Sample size	Intervention	Outcome measures	Results	Comments
Gordis and Markowicz 1971[a]	1967-70	Baltimore primiparous <18 years	RCT	120 experimental 117 control	Comprehensive care (MD, RN, MSW– free) v usual care	Infant mortality hospitalization clinic/EW visits height/weight < 10% number of Immunized	No differences	1. Inadequate power 2 Inadequate morbidity and developmental measures
Kaplan, et al 1972[b]	1969-70	Pittsburgh attendees 2 schools in low-income neighborhood (preschool and school-age children)	Cross sectional	525 experimental 700 control	Enrollment in Children & Youth Health project—daytime program, peals, MSW, RN, public health	School attendance	Small, statistically significant difference with + effect of enrollment status (3.2 days). likely self-selection of healthier children into program (selection bias)	
Moore, and Frank 1973[c]	1968-71	Charlestown school-children undergoing complete physical exam	Cross sectional	991 total 3 groups	Degree of participation in health center–multidisciplinary, comprehensive, free physical exam	Change in absenteeism	No significant change in absenteeism with participation; trend to increased absence	1 Effect of both health center utilization and absenteeism likely confounded by health status 2 Secular trend existed towards increased absenteeism 3 Possible selection bias (no data comparing intervention and control groups)
Alpert, et al 1976[d]	1964-68	Boston, Children's Hospital–poor, no other MD live near hospital	RCT	173 experimental 189 control	Comprehensive medical care program–MD, RN, MSW, v usual care	Child health index utilization, sickness and drug days, satisfaction, cost, process use of preventive services and Immunizations	No significant difference any morbidity measure, simiar frequency outpatient visit with more preventive visits; no significant difference overall hospitalization–more surgical, fewer acute, improved satisfaction with wait and professional relationships, improved process measures	1 Not a representative sample of a given community 2 Eligibility not clear 3 30% dropout–probably not biasing 4 Comparative nature experimental and control groups not documented 5. Specific morbidity measures not noted in report 6. No developmental measures 7 Multiple comparisons for statistical testing 8 Introduction of Medicaid may have minimized effect
Rogers, et al 1974[e]	1970-82	Fort Defiance Indian reservation Arizona—live born infants	Pseudo-randomized trial	116 experimental 119 control	Intensive followup and home visits v. usual care	Infant mortality; health appraisal age 1, uncorrected abnormalities, global health assessment, Hct, DDST (not reported), hospitalizations, and outpatient visits	No significant differences	1 Inadequate power mortality analysis 2 Adequate power for some morbidity outcomes, appropriateness uncertain 3 Confounding of case finding and better care 4 No behavioral outcomes

Augustin, et al 1973[j]	1970-71	NYC children enrolled in Montefiore-Morisania C&Y project	Hybrid design–ISt year enrollees compared to 2nd year	40 total	Not described	Number of Illness visits to clinic during **2nd** year of program partci-pation compared to age matched first year en-rollees hospital days per registrant	35% decrease out-patient visits, decrease in hospitalization rates from O 36 to O 102	1 No description of population 2 No description of program 3 Inadequate control group 4 Time of enrollment and acute needs related (confounded)
Gordis 1973[g]	1968-70	Baltimore residents 5-14 yr in 1) census tracts with comprehen-sive health centers and 2) adjacent, compar-able, and all other tracts	Ecologic[k]	Not relevant 35,068 eligible Incidence 13 5/100,000	Existence of compre-hensive care program in tract	Rheumatic fever inci-dence (rates)	60% decline (p<.005) in rheumatic fever rates in eligible census tracts	1 Ecologic study[k] 2 Not specifically related to child health supervision
Klein, et al 1973	1968-70	Rochester 1 Catchment area residents, 2 Health center users	1. Ecologic **2 Cross sectional**	1 8,000 experi-mental, 7,000 control 2 1,500 to 3,300 users, 6,000 to 4,750 nonusers	Comprehensive, multi-specialty group practice 1 In tract v not in tract 2 Users v nonusers	Hospitalization rates and length of stay	1 Lower hospital ad-mission rates and LOS in control tracts throughout study 2 Users had lower hospitalization rates than nonusers and lower LOS than nonusers or control group	1 Limitations in value of hospitalization rates as outcome 2 Selection bias m use of health center (initial users were low-er risk segment of target population)
Briscoe, et al , 1980[l]	1975 1977	Hazard, Kentucky Sample of all children born at ARH hospital, matched to children born at comparable facility	Cohort study —experi-mental and control groups geograph-ically separate	65 pairs from 177 pairs in original group, 79 pairs m new study group	Home visits (7) for counseling, support, education, and advoca-cy. plus well-child care	Health status physical exam, otitis media. hemoglobin count, iron deficiency, utilization-admissions and out-patient/EW visits	No difference in health status measures, non-significant trend to decreased utilization in experimental group but home visits not in-included	1 Inadequate control population (Increased distance to MD for control group, better insur-ance for intervention group) 2 Inadequate power to detect differences m hospitalization 3 No behavioral outcomes

Abbreviations EW = emergency ward, LOS = length of stay, MD = physician; MSW = medical social worker; RCT = randomized clinical trial, RN = registered nurse

[a] L. Gordis and M Markowictz, "Evaluation of the Effectiveness of Comprehensive and Continuous Pediatric Care, " *Pediatrics* 48:766, 1971.

[b] R S Kaplan, L B. Lave, and S Leinhardt, "The Efficacy of a Comprehensive Health Care Project An Empirical Analysis, " **Am J *Public* Health** 62:924-930, **1972**

[c] G Moore **and** K. Frank, "comprehensive Health Services for Children' An Exploratory Study Of Benefit, " **pediatrics** 51 **17-21,** 1973

[d] J Alpert, L S Robertson, J.K. Kosa, et al , "Delivery of Health Care for Children: Report of an Experiment, " *Pediatrics* **57:917-930, 1976**

[e] K D **Rogers,** R Ernst, I **Shulman**, et **al** , "Effectiveness of Aggressive Followup on Navajo Infant Health and Medical Care Use, " **Pediatrics 53 "721-725** 1974

[f] M S August in, E. Stevens, and D Hicks, "An Evaluation of the Effect iveness of a Children and Youth Project, " *Health Services* **Report 88 "942-946, 1973**

[g] L Gordis, "Effectiveness of Comprehensive-Care Programs in Preventing Rheumatic Fever," N **Eng J Med** 289:331-335, **1973**

[h] M Klein, K Roghmann, K Woodward, et al , "The Impact of the Rochester Neighborhood Health Center on Hospitalization of Children. 1968 to 1970," *Pediatrics* **51 "633-639, 1973**

[l] M E Briscoe, D. L Hochstrasser, G W Somes, et al , "Followup Study of the Impact of a Rural Preventive Care Outreach Program on Children's Health and Use of Medical Services. " **Am J *Public Health* 70151.156, 1960.**

[j] This is a generic problem **of these** evaluation studies but especially strong here

[k] ecologic studies individual experience is not directly measured, rather, such experience is Inferred from measures of aggregate experience A problem with such studies is that the individuals may not experience the exposures attributed to them by virtue of their residence or group membership

SOURCE" Office of Technology Assessment, 1988, based on a background paper by C J Homer, "Evaluation of the Evidence on the Effectiveness of Well-Child Care Services for Child ren, " prepared for the Office of Technology Assessment, U.S Congress, Washington, DC, April 1987

Table J-3.—Effectiveness of Well-Child Care as a Whole: Evaluations of Medicaid's Early Periodic Screening, Diagnosis, and Treatment (EPSDT) Program

Author	Years data collected	Study population	Study design	Sample size	Intervention	Outcome measures	Results	Comments
Irwin and Conroy-Hughes, 1982[a]	1973-80	S E Pennsylvania EPSDT eligible >18 mo. at 1st screen, screened at 2 yr	Before/after with separate controls for each time	1,831 children	Participation in EPSDT program	1 Identification of an abnormal condition requiring treatment 2 Number of treatable conditions identified, standardized for number of conditions tested	1 No difference in crude rates **2 When adjusted** for secular trend of increased identification rates, rescreening was associated with a 26% decrease	1 Results based on speculate adjustment 2 No specific information on importance of conditions 3 No individual health status measures
Keller, 1983[b]	1979	MIchIgan–population eligible for EPSDT entire year	1 Repeated prevalence 2 Cross section users v nonusers	1 16,000 random sample 2 10,000 users, 6,000 nonusers	Participation in EPSDT program	1 Referral rates 2 Costs for partIclpants v nonparticipants, with and without administrative costs	1 Decreased referral rates with Increased screening 2 No consistent change m costs with Increased numbers of screenings 3. Participants cost less than nonparticipants	1 **Same criticisms as comments 2 and 3 above** **2. Nonparticipants are likely different than participants (selection bias)–e.g., nonscreened Medicaid eligible may have "spent down' to get onto Medicaid** roles
Reis, et al , 1984[c]	1972-79		Review of SIX EPSDT demonstration/evaluation projects					**1 Great variability in proportion of eligible population screened (14-85%)** **2 Variation in case finding rates (6-18%)** **3 Although 50-80% of those identified with problems were treated, only 7-18% were judged to achieve maximum benefit** **4 Large proportion of those diagnosed were not previously** Identified

[a] P. H. Irwin and R. Conroy-Hughes, "EPSDT Impact on Health Status: Estimates Based on Secondary Analysis of Administratively Generated Data," *Medical* **Care 20216-234,** 1982.
[b] W Keller, "Study of Selected Outcomes of the Early and Periodic Screening, Diagnosis, and Treatment Program in Michigan," *Public Health* **Reports 98:1** 10-119, 1983.
[c] J S Reis, S R Pliska, and E Hughes, "A Synopsis of Federal-State Sponsored Preventive Child Health," *J. Community Health* 9:222-239, 1964

SOURCE: Office of Technology Assessment, 1988, based on a background paper by C.J. Homer, "Evaluation of the Evidence on the Effectiveness of Well-Child Care Services for Children," prepared for the Office of Technology Assessment, U S Congress, Washington, DC. April 1987.

Table J-4.—Effectiveness of Well-Child Care as a Whole: Comparisons of Health Outcomes in Alternative Health Delivery and Insurance Systems

Author	Years data collected	Study population	Study design	Sample size	Intervention	Outcome measures	Results	Comments
Valdez 1986[a]	1974-82	R C T	Random sample families from six communities some exclusions 0-11 yr	1 844 children	Differing levels of health Insurance	Physilologlc function anemia, middle ear fluid; hearing loss, visual acuity Physical health limitations in daily activity Mental and general health perception	1 Overall no significant difference in health measures with differing levels of insurance 2 Decreased utilization associated with cost sharing–preventwe services decreased by comparable amount to other services 3 For poor children who were anemic at outset of study 8% of those in free care were anemic by the end of the study, compared to 22% of those in cost sharing	1. Sample attrition 30% 2 Plans not representative of those generally available to the poor 3 Inadequate power for examination of role limitations and for subgroup analyses 4 Growth and developmental outcomes not reported
Kessner et al 1974[b]	1970-71	Cross sectional	Washington, DC Random sample from specific neighborhoods, predominantly black, 6 me-l 1 yr	1,436 families 2,780 children	Six different types of providers, including both prepaid and fee-for service	‘ Tracer” condtlons- 1. Middle ear infection/ hearing loss 2 Iron deficiency anemia 3 Visual disorders	1 Provider type had no significant influence on health status measures after controlling for socioeconomic status 2 Tests often not performed as often as recommended 3 Abnormal results often not followed with treatment	1 Generalizability limited with 1 city, black population, large numbers of inner-city solo practitioners 2 Question of adequate controlling for socioeconomic status 3 Question regarding aggregation of provider types 4 Implications for preventive care uncertain, if valid, implication is that although prepaid programs provided more preventive care, outcomes no different
Dutton and Silber, 1980[c]	1970-71	Reanalyses of Kessner data	Washington DC Random sample from specific neighborhoods predominantly black, 6 mo-11 yr	1,436 families 2,780 children	Different types of providers	‘Tracer’ conditions– 1. Middle ear infection/ hearing loss 2 Iron deficiency anemia 3 Visual disorders	Trend toward lower health status for users of solo practitioners relative to users of prepaid or **OPD care** **Lower satisfaction with** OPD use	1 Question regarding generalizability 2 Aggregate effect very small 3 Question appropriateness of linking OPD and prepaid care schemes

Abbreviations OPD – outpatient delivery clinic; RCT = randomized clinical trial

[a] R o B Valdez *The Effects of Cost Sharing on the Health of* Children, R-3270-HHS **(Santa Monica,** CA Rand Corp , 1986)

[b] D" M" Kessner, C K Snow and J Singer, *Assessment of Medical Care* **for** *Children* (Washington, DC: National Academy of Sciences, 1974)

[c] B. Dutton and R S Silber, “Children’s Health Outcomes in Six Different Ambulatory Care Delivery System s,” **Medical Care 18693-714,** 1980

SOURCE: Off Ice of Technology Assessment, 1988, based on a background paper by C J Homer, “Evaluation of the Evidence on the Effectiveness of Well-Child Care Services for Children, ” prepared for the Office of Technology Assessment, U S Congress, Washington, DC, April 1987

Table J-5.—Effectiveness of Well-Child Care as a Whole: Studies of the Effects of Well. Child Care on Developmental Outcomes

Author	Years data collected	Study population	Study design	Sample size	Intervention	Outcome measures	Results	Comments
Cullen, 1976[a]	1964-73	Rural W Australia other criteria not stated	Stratified, men randomized (RCT)	101 families 122 children each group	20-30 minute interview every 3 mo. m 1st yr; then every 6 mo, for 4 yr, emphasis on gentleness, positive outlook	1. Behavior symptoms 2 Family relations 3 Readiness for work 4 Basic learning ability 5 Early school personality 6. Stan-Binet vocab 7 Describe a picture 8. Spontaneous speech 9. Draw a man	Fewer fears, more school lateness, many behaviors with no differences, boys m intervention groups generally became worse m school performance and behavior; no effect for girls	Sample uncertain Generalizability uncertain Intervention not standardized Importance of outcomes unclear Plausibility of sex interaction limited
Gutelius, et al., 1977[b]	1965-76 (enrolled 1965-69 with 6 year followup)	Urban Washington, DC, primigravid 15-18-year-old mothers with early prenatal care, IQ >70; no neonatal problems	RCT	47 experimental 48 control	Pediatrician and nurse well-child visits in motor coach, 1 hour each; additional nurse visits-total 18/12/8 1st 3 yr, Group counseling, medicinal iron, cognitive stimulation program	Bayley Stanford-Binet WISC-R Behavior profile School readiness	Cognitive: decreasing differences after age 3 Behavioral: improved social and self-confidence scores at age 3, fewer behavior problems age 5 on; improved school completion by expectant mothers as program evolved	Generalizability limited due to nature of study population and intensity of program, outcome assessment not blinded; intervention unstandardized; late attrition in control group of better Performers
Chamberlain and Szumowski. 1980[c]	1976-79	Rochester, primiparous mother recruited from pediatricians	Cohort	371 total	Various levels and methods of extensive parent education m pediatrician offices (e.g., discussions, handouts, shale presentations)	Maternal knowledge, attitudes, child-rearing style Child" behavior, development	Increased knowledge with increased teaching; no effect on development, in-increased reported behavior problems, small but significant correlation teaching and positive interaction	**Middle class population, all providers in one practice given average rating (measurement error); attrition to lower socioeconomic status families, regression technique may have masked study effect by including intervening variable; question selection bias**
Casey and Whitt, 1980[d]	1977-78	North Carolina, primiparous mothers, no medical complications, no Identified source of pediatric care	RCT (randomized after stratification)	15 experimental 17 control (of 59 eligible)	Counseling emphasizing affective interaction; control of well-child care by same MD (all intervention by one physician)	8 scales maternal-Infant interaction; Bayley, object permanence and vocal Imitation scales	All scales favored intervention; significant differences 4/8 No significant difference Bayley; vocal imitation favored Intervention $p<0.1$	**Short followup; outcome measures of uncertain significance; power limited; generalizability limited by population and perhaps nature of intervention (unique to provider?)**

Abbreviations: RCT = randomized clinical trial; WISC-R = Wechsler intelligence scale for children

[a] K.J Cullen, "A Six-Year Controlled Trial of Prevention of Children's Behavior Disorders, " *J. Pediatrics* 88:662-666, 1976

[b] M. F, Gutelius, A.D. Kirsch, S. MacDonald, et al., "Controlled Study of Child Health Supervision" Behavioral Results, " *Pediatrics* 60:294-304, 1977.

[c] R.W. Chamberlin and B.A. Szumowski, "A Followup Study of Parent Education in Pediatric Office Practices: Impact at Age Two and a Half," *Am J. Public Health* 70:1 160-1188, 1980

[d] P., " Casey and J.K. Whitt, '(Effect of the Pediatrician on the Mother-Infant Relationship," **Pediatrics 65:81 5-820, 1980**

SOURCE: Office of Technology Assessment, 1988, based on a background paper by C.J. Homer, "Evaluation of the Evidence on the Effectiveness of Well-Child Care Services for Child ren, " prepared for the Office of Technology Assessment, U.S Congress, Washington, DC, April 1987

Table J-6.—Studies of the Effectiveness of the General Physical Examination in Well-Child Care

Author	Years data collected	Sample	Method of data collection	Validation	Reliability assessment	Utility assessment	Definition of exam	Yield	Comments
Infant:									
Anderson, 1970[a]	**1969**	**44% practicing Connecticut pediatricians, 100 consecutive well-child exams**	**Physician report of abnormality**	None	None	None	Physical exam or "routine" lab tests only	11.4% of exams resulted in abnormality, 1.9% in significant abnormality, 80% discovered by 6 mo.	Parents unaware of abnormalities needing prescription 62% of time Study of limited value
Preschool:									
O'Connell and Friesen 1976b	1970	382 born m Mayo clinic, underwent preschool exam and entered KG 1970	Chart review	None	None	None	Preschool exam which included history, physical exam, watch hearing test, and Snellen vision test	3 1‘Yo **of exams** resulted in previously undetected abnormalities	Biases in sample selection
Welch and Kesler, 1982[c]	1978	1 158 entering KG Roanoke Virginia 1977	Comparison of school screening program with written physician preschool report	Study in one sense IS validation of prior physician exam, screening positive findings "confirmed	Not clearly specified screeners underwent training	None	School-based screening tests physician's exam included weight, height, vision, hearing blood pressure, and caries	**33% of children had abnormalities, 91%** of **these detected by screening, 30% detected by** physician exam	Abnormalities detected by exam and not screened for are not discussed
School aged:									
Yankauer and Lawrence, 1955[d]	1952-53	1,056 1st grade children from representative sample of schools	Examined by 1 MD, vision, hearing, and dental problems not included	Limited–if in doubt a second oplmon was sought	None	163 conditions initially identified, 99 still present in grade 4, most new conditions also present grade 4, ENT and emotional problems most likely to Improve, emotional problems least likely to be in care	Patient history as well as a physical exam	21% of children had abnormality, 78% under care and 12% more known, If preschool family MD exam, condition more likely under care	Relies on adequacy of care by an outside (family) physician
Yankauer and Lawrence 1956[e]	1952-56	617 of above remaining for 3 years and 284 remaining 1 or 2 years	Same as Yankauer and Lawrence 1955[d]	Same as Yankauer and Lawrence, 1955[d]	None	Same as Yankauer and Lawrence 1955[d]	Same as Yankauer and Lawrence, 1955[d]	14% develop new condition. primarily emotional and ENT, 50% under care before school exam	1 /251 exams resulted m a condition diag nosed not already under treatment

Table J-6.—Studies of the Effectiveness of the General Physical Examination in Well-Child Care-Continued

Author	Years data collected	Sample	Method of data collection	Validation	Reliability assessment	Utility assessment	Definition of exam	Yield	Comments
Yankauer, et al , 1957[e]	1952-56	617 of above remaining for 3 years and 284 remaining 1 or 2 years	et al., 1957[e] 1952-56 and Lawrence, 1955d	617 of above remaining for 1 9 5 5[d]	None	Same as Yankauer and Lawrence 1955[d]	Same as Yankauer and Lawrence 1955[d]	See "Utility assessment"	No examination of "labehng'
Grant, et al , 1973[g]	1967-70	6,058 students in El Paso schools undergoing annual screening. age 5-18 yr	Paramedic screening tests, physician physical exam, rashes, acute illnesses, emotional problems excluded	None	None	None (authors judged a detected condition worthwhile even if referral resulted in a "diagnosis" of no significance. such as functional murmur)	Not specified	13 4% had abnormality detected– 9.5% by screening, 3.9% by exam	37% of all abnormalities were due to inadequate vision
Kohler 1977[h]	1969-72	649 children age 7 in one town in Sweden	Author examined all students	None	None	None	Physical exam is included growth parameters and urinalysis	15% had abnormality detected, half were vision problems, half previously known physical examination detected functionally important abnormality in 6.5%	None
DeAngelis, et al., 1983[i]	1980-81	12,997 rural students, little access to medical care, nurse practioners	Aides administered screening tests Nurse practitioner did physical exam	None	None	None	Not specified	34% of students undergoing physical examination had a problem identified, only 17% previously known	Little overlap in conditions, acute, self-imited problems in eluded, no utility measure

Abbreviations ENT = ear, nose, and throat; KG = kindergarten; MD = physician.

[a] F.P Anderson, "Evaluation of the Routine Physical Examination of Infants in the First Year of Life," *Pediatrics* 45:950-964, 1970
[b] E.J. O'Connell and C.D Friesen, "The Preschool Physical Examination" *Clinical Pediatrics* 15:930-931, 1976
[c] N.M Welch and R.W Kesler, "The Value of the Preschool Examination in Screening for Health Problems," J *Pediatrics* 100:232-234, 1982.
[d] A. Yankauer and R.A Lawrence, "A Study of periodic School Medical Examinations—I. Methodology and Initial Findings, " *Am J. Public Health* 4571-78, 1955
[e] A. Yankauer and R. Lawrence, "A Study of Periodic School Medical Examinations —II. The Annual Increment of New 'Defects'," Am. J *Public Health* 55:1553-1562, 1956.
[f] A. Yankauer, R Lawrence, and L. Ballou, "A Study of Periodic School Medical Examinations—III The Remediability of Certain Categories of 'Defects'," Am J Public Health 47 1421-142% 1957
[g] W.W Grant, R.G Fearnow, L.M Hebertson, et al., "Health Screening in School-Age Children," Am. J. *Dis. Child.* 125 "520522, 1973.
[h] L. Kohler, "Physical Mass Examinations in the School Health Service," *Acta Paediatr. Scand* 66:307-310, 1977.
[i] C. DeAngel Is, B. Berman, D. Oda, et al., "Comparative Values of School Physical Examinations and Mass Screening Tests," *J. Pediatrics* 102:477-481, 1983

SOURCE Office of Technology Assessment, 198S. based on a background paPer by C.J. Homer, "Evaluation of the Evidence on the Effectiveness of Wel--Child Care Services for Children," prepared for the Office of Technology Assessment, U.S. Congress, Washington, DC, April 1987.

Table J.7.—Studies of the Predictive Validity of the Denver Developmental Screening Test (DDST)

Author	Years data collected	Sample characteristics	Outcome measures	Prevalence of school failure	Sensitivity	Specificity
Camp, et al 1977[a]	1969-72	Low-income Denver residents using a Neighborhood Health Center, took DDST, If abnormal, asked back, if normal, some asked back, of these, those over 8 years old before 9/73 and still living in Denver in the public schools were included, 493 initially came back, 92 met age criteria; followup on 65 of 92	Special class or repeat achievement test >1.5 years behind Significant teacher rated behavior problem Diagnosis of hyperactivity IQ below 80	57% with either la below 80 or learning problem	78%	60%
Cadman et al., 1987[b]	1980-84	All children registering for normal kindergarten m three or four regions of Niagara, Ontario, children randomized to receive DDST with counseling, DDST without counseling, and no DDST, all abnormals and random sample of others underwent further testing	Teacher and parent reported learning problems Child not in regular class Parental worry WRAT WISC-R Child Well Being Questionnaire	9% not in regular 2nd grade class	6%	99%
Sturner, et al., 1985[c]	1978-80	All children registering for kindergarten in Person County, North Carolina, screened with DDST-S; followup testing on differing proportions of abnormals (100%), questionables (50%), and normals (10%)	Special class or repeat CAT-R < 20th percentile	27% not regular class or < 20th percentile on CAT-R	57% stage 26%-2 stage	87%-1 stage 94%-2 stage

Abbreviations: WISC-R = Wechsler intelligence scale for children, WRAT – Wide Range Achievement Test

[a] B W Camp, W J van Doorninck, W K Frankenburg, et al., "Preschool Developmental Testing in Prediction of School Problems," *Clinical Pediatrics* 16:257-263, 1977

[b] D Cadman, L W Chambers, S D Walter, et al., "Evacuation of Public Health Preschool Child Developmental Screening: The Process and Outcomes of a Community Program," **Am. J Public Health** 77:45-51, 1987

[c] R A Sturner, J A Green, and S.G Funk, "Preschool Denver Developmental Screening Test as a Predictor of Later School Problems," *J.* **Pediatrics** 107:615-621, **1985**

SOURCE: Office of Technology Assessment, 1988, based on a background paper by C.J Homer, "Evaluation of the Evidence on the Effectiveness of Well.Child Care Services for Children," prepared for the Office of Technology Assessment, U.S. Congress, Washington, DC, April 1987

Table J-8.—Studies of the Effectiveness of Anticipatory Guidance on Child Safety Restraint Use

Author	Years	Site/pratice style	Sample size	Allocation method	Intervention	Outcome assessment	Results	Comments
Bass and Wilson, 1964[a]	1962-63	Pittsburgh/private practice	1,423	1. Control group = users one practice 2 Different experimental groups = users another practice at different times	1. Letter by MD 2 Letter by MD + counseling 3 Letter by safety organization	Maternal report of seat-belt Installation, by phone	19.6% no Information, 19.1% organization letter, 15 3% MD letter, 43% MD letter + counseling	Concerns regarding biases m allocation and assessment
Kanthor, 1976[b]	1974-75	Rochester/prepaid health plan	16 experimental (Quasi-random (every 19 control	other infant born)	1 Counseling by MD + pamphlet at prenatal Visit; control = no education	Maternal report, occasionally verified	42% use no Information, 69% information (p=0.21)	Small sample size bias m assessment no significant difference
Allen and Bergman, 1976[c]	1974-75	Seattle/prepaid health plan	202 of 500 eligible	Volunteers for nonconcurrent intervention groups	1 Informational material only 2 Informational material + film presentation 3. Informational material, film presentation, and rehearsal of car seat use, control = no information (postpartum)	Maternal report– questionnaire	1. 37% no Information 2. 54% Information only 3. 71% Information + film only 4 60% information + film + rehearsal	Selection bias assessment bias not necessarily relevant to office practice
Scherz, 1976[d]	1970-74	Tacoma/military well-child care	500	Random allocation	1. No reformation 2. Display 3. Display + pamphlet 4. Display + pamphlet + nurse counseling 5. Display + pamphlet + MD counseling	Maternal report-questionnaire at 8 weeks and 9-12 mo.	At 8 weeks/12 months, % safe = 1) 9/77 2) 12/74 3) 8/75 4) 22/81 5) 13/88	Bias in assessment due to military population
Miller and Pless, 1977[e]	1975-76	Rochester/pediatric group practice	654 (age 0-17)	Randomized	1 Pamphlet + verbal information 2. Pamphlet + verbal + slide/tape, control = no education	Maternal questionnaire, rough validation with direct observation	No significant differences between control m either intervention group	Power not a "physl-clan' intervention per se
Reisinger and Williams, 1978'	1976-77	PNtsburgh/in-hosptal program	1,107	Consecutive time intervals (nonconcurrent controls)	Control = no education 1 Literature only 2 Literature + health educator 3. Literature + free car seat	Direct observation at hospital discharge and 2 mo. followup	Very low use at time of hospital discharge, no study effect, gradient from control to free seat with use at 2 mo.,i.e., 26%/31%/36%/41 %. Only free group had statistically significant difference from control	Rates may be inflated compared to general population m that more educated parents are both more likely to use seat belts and to come for followup
Reosomger, et al , 1981[g]	1978-79	Pittsburgh/private practice	269	Nonconcurrent intervention and control periods	Control = no information Study = education by pediatrician with discussion, pamphlet, and demonstration	Direct observation at 1, 2, 4, 9, 15 mo.	Significant difference at 2 mo. (50 v 29%); no difference from 4 mo. thereafter	Attrition ranged from 10-23%

Abbreviation: MD = physician.

[a] L.W. Bass and T R, Wilson, "The pediatrician's Influence in private practice Measured by a Controlled Seat Belt Study," **Pediatrics 33:700-704, 1964.**

[b] H.A. Kanthor, "Car Safety for Infants: Effectiveness of Prenatal Counseling," *Pediatrics* 58:320-322, 1976

[c] D. B, Allen and A.B. Bergman, "Social Learning Approaches to Health Education: Utilization of Infant Auto Restraint Devices, " **Pediatrics 58:323-328, 1976,**

[d] R.G. Scherz, " Restraint Systems for the prevention of Injury to Children in Automobile Accidents," **Am. J. Public Health 66:451-456, 1976.**

[e] J.R. Miller and I.B. Pless. "Child Automobile Restraints Evaluation of Health Education, " *Pediatrics* 59:907-911, 1977.

[f] K.S. Reisinger and A.F. Williams, "Evaluation of Programs Designed To Increase the Protection of Infants in Cars," **Pediatrics 62260-287, 1978.**

[g] K.S. Reisinger, A.F Williams, J.K. Wells, et al , "Effects of Pediatricians' Counseling on Infant Restraint Use, " **Pediatrics 67 "201-206, 1981**

SOURCE: Office of Technology Assessment, 1968, based on a background paper by C.J. Homer, "Evaluation of the Evidence on the Effectiveness of Well-Child Care Services for Children, " prepared for the Office of Technology Assessment, U.S. Congress, Washington, DC, April 1987.

Table J-9.—Recent Economic Evaluations of Childhood Vaccination Programs[a]

Author	Type of vaccine	Alternative compared	Population studied	Costs and benefits considered	Findings	Critical assumptions	Comments
Cochi, et al 1985[a]	Hib	1 Hib vaccination at 18 mo. v. no vaccination	U S population 1-2 yrs old	Direct medical costs and benefits	Net benefit in direct short- and long-term savings = $307 million	Cost of vaccine = $3/dose No additional administrative cost because in conjunction with 18-mo DTP visit 80% coverage 75% efficacy	Sensitivity analysis performed for alternative strategies, varied efficacy, coverage incidence and cost of vaccine, no discounting of acute case costs saved Long-term costs discounted at 5%
		2 Hib vaccinationlnat!on at 24 mo. v no vaccination			Net benefit in direct short- and long-term savings = $1 1 million	Cost includes $10 administration fee, since visit is not in conjunction with scheduled DTP visit 80% coverage 90% efficacy	
Hay and Daum, 1987[b]	Hib	Hib vaccine at 24 mo v. no vaccination	1984 U S birth COhort (from O-5 yr)	Direct and Indirect costs and benefits including an economic valuation of life	Net savings of $648 million	60% vaccine coverage Vaccine cost =$8. 13/dose Office visit cost =$20 70% efficacy	Many other strategies were considered as well, including rifampin prophylaxis, sensitivity analysis was performed
White, et al 1985[c]	MMR	MMR vaccination v single antigen vaccination v no vaccination	U S population (examined actual 1983 data)	Direct and Indirect costs and benefits	Combined vaccine (MMR) benefit-cost ratio = 1341 Single antigen vaccine benefit-cost ratios measles = 11.91 rubella = 771 mumps = 6 7 1 Savings due to use of combined rather than single antigen vaccine = $60 million	Vaccine costs office visit = $15.00 measles = $426 rubella == $476 mumps = $5.57 MMR = $1130 Discount rate = 10%	Based on actual and estimated data for 1983
Bloch, et al , 1985[d]	Measles	Measles vaccination program, 1963-82 v no vaccination program, 1963-82	U S population	Direct and indirect costs and benefits	Net savings for the 20-year period (1963-82) = $51 billion	Unspecified	Comprehensive review of benefits due to measles vaccination from 1963-82, based on previously published studies
Preblud, et al , 1985[e]	Varicella (chickenpox)	Varicella vaccination in conjunction with MMR (1 dose at 15 mo.) v no vaccination	Hypothetical birth cohort of 3,5 million (a size approximating that of the U S) normal individuals followed from birth to their 30th birthday	Direct medical and home care costs (those associated with lost work time by someone other than the patient)	Overall benefit-cost ratio = 6 9 1 Net savings of $262 million	No administration cost because administered in conjunction with MMR Coverage = 90% Efficacy = 90% No herd Immunity Discount rate = 5%	Sensitivity analysis performed for best- and worst-case scenarios Home care costs accounted for 95% of the disease-related costs

Table J-9.— Recent Economic Evaluations of Childhood Vaccination Programs[a]—Continued

Author	Type of vaccine	Alternate compared	Population studied	Costs and benefits considered	Findings	Critical assumptions	Comments
Hinman and Koplan, 1984[f]	Pertussis	Pertussis vaccination in conjunction with DT vaccines (5 doses, 0-6 yr) v no vaccination (DT vaccine only)	Hypothetical cohort of 1 million children, based on U K. incidence rates (because less underreporting than U. S.) and extrapolated to U.S. population	Direct medical costs and benefits	The benefit-cost ratio (reduction in disease costs divided by program costs) Is 11 1 1	**90% coverage (5 doses) 80% efficacy Vaccine cost=$0.03/dose No administrative cost because administered m conjunction with DT Discount rate = 5%**	Sensitivity analysis performed for the following 1 assuming no herd immunity 2 assuming all children with convulsion, collapse, or high-pitched cry following vaccination seek medical care
White and Axnick, 1975[g,p]	Measles	**Measles vaccination as implemented 1963-72 v no measles vaccine**	U S. population	Direct and redirect benefits and costs	Net benefit achieved through immunization was $1 3 billion over 10-yr period	Costs of production, distribution, administration, and promotion of vaccine is $3 00/dose	Basis for monetary estimate of direct and indirect benefits not given Costs and benefits not discounted
Axnick, et al 1969[h,p]	Measles	Measles vaccination as implemented 1963-68 v. no vaccination	U.S. population	Direct and indirect costs and benefits due to vaccination	National net direct benefits $200 million, net direct and indirect benefits m period 1963-68 were $531 million	**Physician office visit cost= $73/day for measles encephalitis; =$40/day for hospitalized measles cases**	Some benefits and costs not discounted Direct costs for each year estimated m current dollars
Ambrosch and Wiedermann, 1979[i,p]	**Measles and mumps**	Measles and mumps vaccination of 1-yr-olds v no vaccination	Austrian population	Direct costs of immunization and therapy and indirect costs of lost work time for mothers	Over a 12-yr period of vaccinations, net direct benefits are positive (at 1681 90 Austrian Shillings per child)	**Vaccine acceptance is 100%; 20% of mothers are employed; 5 days mothers' work time lost for measles and mumps**	Costs not discounted over time
Massachusetts Department of Health, 1980[j,p]	MMR	MMR vaccination program run by State v. no program	Massachusetts population	Direct costs of vaccinations and medical care associated with the disease	Cumulative effect of MMR program since 1966 has saved the State $14,1 million	Unknown, not well described	Basis for monetary estimates not given; costs over time not discounted
Ekblom, et al , 1978[k,p]	Measles	Measles vaccination of all 1-yr-olds v. no vaccination	Population of Finland	Cumulative discounted net direct and indirect benefits 1975-99	Total benefits outweigh total costs by third year of study, ratio of net benefit to cost Is 3:1-4:1	Discount rate = 9%	Basis for monetary estimates not given
Koplan and Preblud, 1982[l,p]	**Mumps**	Mumps vaccine m conjunction with measles and rubella v. measles and rubella vaccine only	U S population	Direct and Indirect costs and benefits	**Vaccination saves approximately $5.4 million per million vaccines**	Discount rate = 5% Cost of mumps vaccination = $100	Vaccination program is that recommended by American Academy of Pediatrics (vaccinations of 1-yr-olds)

Schoenbaum, et al 1976[m,p]	**Rubella**	Rubella vaccination of 2-yr-old children as part of measles and mumps vaccine v vaccination of 6-yr-old children with monovalent vaccine v vaccination of 12-yr-old females with monovalent vaccine	U S population	Direct costs of vaccination v direct and indirect costs of congenital rubella syndrome	Ratio of benefit to cost is 25:1 for 12-yr-old girls, 91 for 6-yr-old children. and 231 for 2-yr-old children	Compliance for all ages in 80% No 12-yr-old girls would be pregnant at time of vaccination	Compliance in infants is likely to be higher than Compliance in 12-yr-olds Herd Immunity not considered
Farber and Finkelstein, 1979[n,p]	Rubella	Premarital testing for rubella antibodies m area with a childhood MMR vaccination program v childhood rubella vaccination only	**U S** population	Net direct and Indirect costs and benefits	Testing program would not have positive net benefits unless compliance with vaccination is at least 37% and test cost less than $55	Without testing program, incidence of congenital rubella syndrome would be same as current experience	Sensitivity analysis performed for different assumptions about under reporting of rubella incidence
Koplan, et al , 1979[o,p]	Pertussis	Pertussis vaccination in conjunction with diphtheria and tetanus (DTP) vaccines v. DT vaccine only	U S infant population	Direct medical costs per pertussis case prevented and life saved	Net direct costs of medical care are negative (i.e pertussis vaccine is cost-saving); pertussis vaccine saves 56 deaths per 1 million vaccines	90% Immunization coverage (acceptance); 70% vacine efficacy; serious vaccine complications: convulsions, 1 m 3,500, encephalitis, 1 m 50,000; case fatality from these complications same as for pertussis	Vaccination program is that recommended by American Academy of Pediatrics Vaccine administration costs are minimal because pertussis can be combined with DT innoculations

Abbreviations DT = diphtheria, tetanus Hib = *Haemophilus /n fluenzae* type b; MMR = measles, mumps, and rubella

[a] S. L. Cochi, c v Broome, and A.W. H ightower, "Immunization of U.S. Children With *Haemophilus Influenzae* Type b Polysaccharide Vaccine A Cost.Effectiveness Model of Strategy Assessment," *J A* M A. 253(4):521-529, 1985.

[b] J W. Hay and R S. Daum, "Cost Benefit Analysis of Two Strategies for Prevention of *Haemophilus Influenzae* Type b Infection " *Pediatrics* 80(3):319-330, **1987.**

[c,c,c] White, J P Koplan, and W.A. Orenstein, "Benefits, Risks and Costs of Immunization for Measles, Mumps and Rubella, " **Am** *J. Public Health 75(7)739-744,* **1985**

[d] A B. Bloch, W.A. Orenstein, H.C. Stetler, et al., "Health Impact of Measles Vaccination in the United States," **Pediatrics 76(4)524-532, 1985.**

[e] S.P. Preblud, W **A. Orenstein,** J.P. Koplan, et al , "A Benefit-Cost Analysis of a Childhood Varicella Vaccination Programmed, " **Postgraduate** *Medical J* 61(suppl. **4) "17-22, 1985**

[f] A.R. Hinman and J.P. Koplan, "Pertussis and Pertussis Vaccine: Reanalysis of Benefits, Risks, and Costs, " *J.A* **MA.** 251(23):3109-31 13, 1984

[g] J. Witte and N Axnick, "The Benefits From 10 Years of Measles Immunization in the United States, " *Public Health Reports* **90(3)205-207,** May-June 1975

[h] N. Axnick, S. Shaven, and J. Witte, "Benefits Due to Immunization Against Measles," *Public Health Reports* 84(8):673-680, August 1969

[i] F Am brosch, and G. Wiederman, "Costs and Benefits of Measles and Mumps Immunization in Austria, " *Bull.WHO* 57(4):625-629, 1979.

[j] Massachusetts Department of Health, "Report on the Measles, Mumps, and Rubella Immunization Programs," Boston, MA, March 1980

[k] M. Ekblom, O. Elo, and P. Niemela, " Costs and Benefits of Measles Vaccination in Finland, " *Scandinavian J. Soc.* **Med.** 6(3):1 **11-115,** 1978.

[l,p] Koplan and S R Preblud, "**A Benefit-Cost Analysis of Mumps Vaccine,"** Am. J. *Dis. Child.* 136:362-364, April 1982

[m] S.C. Schoenbaum, J .N Hyde, Jr., L Bartoshevsky, et al , "Benefit-Cost Analysis of Rubella Vaccination Policy, " *N Eng J.* Med 294(6) 306-310, 1976.

[n] M. Farber and S. Finkelstein, "A Cost-Benefit Analysis of a Mandatory Premarital Rubella-Antibody Screening Program," N. *Eng. J* **Med** 300(15):856-859, **1979**

[o,p] Koplan, S.C Schoenbaum, M C. Weinstein, et al., "Pertussis Vaccine: An Analysis of Benefits, Risks and Costs, " *N.Eng.J.* **Med 301(1 7).906-911, 1979**

[p] **Based on** J.L. **Wagner, "The Economic Evaluation of Medicines: A Review of the Literature, " prepared for the Pharmaceutical Manufacturers' Association, Washington, DC. August 1982**

[q] **The Weisbrod study of the net benefits of medical research on poliomyelitis (B.A.** Weisbrod, "Costs and Benefits of Medical Research: A Case Study of Poliomyelitis, " *J Political Economy* 79(3):527-544, 1971) was not included **because it does not address immunization policy per se**

[r] **The term "direct costs and** benefits'' **refers to medical costs Incurred or averted. The term "Indirect costs or benefits" refers to** the economic value of lost productivity incurred or averted

SOURCE Off Ice of Technology Assessment, 1988, adapted in part from J.L. Wagner, "The Economic Evaluation of Medicines A Review of the Literature, " prepared for the Pharmaceutical Manufacturers' Association, Washington, DC, August 1982