Journal of Cystic Fibrosis 14 (2015) 194–202

www.elsevier.com/locate/jcf

Original Article

Cost-effectiveness of newborn screening for cystic fibrosis determined with real-life data

C.P.B. van der Ploeg [a,*], M.E. van den Akker-van Marle [b], A.M.M. Vernooij-van Langen [c,d], L.H. Elvers [d], J.J.P. Gille [e], P.H. Verkerk [a], J.E. Dankert-Roelse [f], on behalf of the CHOPIN study group [1]

[a] *Department of Child Health, TNO, Leiden, The Netherlands*
[b] *Department of Medical Decision Making, Leiden University Medical Center, Leiden, The Netherlands*
[c] *Department of Research and Innovation, Atrium Medical Center, Heerlen, The Netherlands*
[d] *Laboratory for Infectious Diseases and Perinatal Screening, RIVM, Bilthoven, The Netherlands*
[e] *Department of Clinical Genetics, VU University Medical Center, Amsterdam, The Netherlands*
[f] *Department of Pediatrics, Atrium Medical Center, Heerlen, The Netherlands*

Received 23 June 2014; revised 19 August 2014; accepted 19 August 2014
Available online 10 September 2014

Abstract

Background: Previous cost-effectiveness studies using data from the literature showed that newborn screening for cystic fibrosis (NBSCF) is a good economic option with positive health effects and longer survival.
Methods: We used primary data to compare cost-effectiveness of four screening strategies for NBSCF, i.e. immunoreactive trypsinogen-testing followed by pancreatitis-associated protein-testing (IRT–PAP), IRT–DNA, IRT–DNA–sequencing, and IRT–PAP–DNA–sequencing, each compared to no-screening. A previously developed decision analysis model for NBSCF was fed with model parameters mainly based on a study evaluating two novel screening strategies among 145,499 newborns in The Netherlands.
Results: The four screening strategies had cost-effectiveness ratios varying from €23,600 to €29,200 per life-year gained. IRT–PAP had the most favourable cost-effectiveness ratio. Additional life-years can be gained by IRT–DNA but against higher costs. When treatment costs reduce with 5% due to early diagnosis, screening will lead to financial savings.
Conclusion: NBSCF is as an economically justifiable public health initiative. Of the four strategies tested IRT–PAP is the most economic and this finding should be included in any decision making model, when considering implementation of newborn screening for CF.

Keywords: Cystic fibrosis; Newborn screening; Cost-effectiveness

* Corresponding author at: TNO — Dept. of Child Health, PO Box 3005, 2301 DA Leiden, The Netherlands. Tel.: +31 88 8666269.
E-mail address: Kitty.vanderPloeg@tno.nl (C.P.B. van der Ploeg).

[1] CHOPIN study group: J E Dankert-Roelse, MD, PhD, A M M Vernooij-van Langen, MD (Atrium Medical Centre); J G Loeber, PhD, L H Elvers (RIVM); R H Triepels, PhD (St. Elisabeth Hospital); J J P Gille, PhD (VUmc); C P B Van der Ploeg, PhD, S M van der Pal, PhD (TNO); E Dompeling, MD, PhD (MUMC); G Pals, PhD (VU Medical Centre), M E van den Akker van Marle, PhD (LUMC); V A M Gulmans, PhD (NCFS, Dutch CF Foundation), M J W Oey-Spauwen, MD, Y H H M Wijnands, MD, L M Castricum, MD (RIVM); H G M Arets, MD, PhD, Professor C K van der Ent, MD, PhD (University Medical Centre Utrecht); Professor H A W M Tiddens, MD, PhD, Y B de Rijke, PhD (Erasmus Medical Centre Rotterdam); J B Yntema, MD, PhD (Radboud University Nijmegen Medical Centre).

http://dx.doi.org/10.1016/j.jcf.2014.08.007

1. Introduction

Cystic fibrosis (CF) is one of the commonest autosomal recessively inherited disorders in Caucasian populations. Early detection of patients with CF by newborn screening aims to start treatment as early as possible to prevent malnutrition and irreversible lung damage.

Previously, we assessed the cost-effectiveness of newborn screening for CF (NBSCF) on a hypothetical birth cohort for different screening strategies based on immunoreactive trypsinogen (IRT) and DNA testing. This study, using a decision analysis model with data from the literature, showed that NBSCF is a good economic option, with positive health effects being expected [1]. Subsequently, in 2008 and 2009 we

Table 1
Model parameters: base-case values and lower and upper values in sensitivity analysis, and distribution for the probabilistic multivariate sensitivity analysis.

Model parameter	Base-case value	Lower value sensitivity analysis	Upper value sensitivity analysis	Distribution
Epidemiology				
Yearly number of neonates born in The Netherlands	185,000			
Participation CF-screening	99.7%	99.5%	99.8%	Triangular
Incidence of CF (classic)	0.021% (1 per 4750)	0.018% (1 per 5500)		Triangular
% newborns with meconium ileus	17%	15%	19%	Triangular
Sensitivity and specificity				
Sensitivity IRT-test (cut-off 60 μg/l)	95.6%	90%	100%	Triangular
Sensitivity PAP-test	95%	90%	100%	Triangular
Sensitivity DNA-test	99%	95%	100%	Binomial
Sensitivity sequencing	100%	97%		Uniform
Specificity IRT-test (cut-off 60 μg/l)	98.99%	98.94%	99.04%	Poisson
Specificity PAP-test	89.99%	88.32%	91.46%	Binomial
Specificity DNA-test	100%			
Specificity sequencing	100%			
Mutations at DNA-test and need for sequencing				
% infants with positive IRT test having 1 mutation at DNA-test	4.6%			
% infants with positive IRT–PAP having 1 mutation at DNA-test	5.4%			
% CF patients with 1 mutation detected by DNA-test	11%	5%	17%	Binomial
Health effects				
CF mortality in childhood (at age of 5 years)	6%	3%	10%	Triangular
Reduction in childhood CF mortality due to screening	25%		50%	Uniform
No of life-years gained per prevented death due to screening (3% discounting)	40 (20.5)	35 (19.4)	45 (21.8)	Triangular
% parents opting for genetic counselling	50%	40%	90%	Triangular
% parents testing carrier status after genetic counselling	80%	50%	90%	Triangular
Costs (€)				
Adding CF screening to newborn screening programme	153,716	100,000	200,000	Triangular
IRT test	2.28			
PAP test	294,413 for a year cohort (155 per test)	200,000		Uniform
DNA test	166 (IRT–DNA–seq) 231 (IRT–PAP–DNA–seq)			
Sequencing	417			
Sweat test	274 (1st test) 206 (repeated test)			
Genetic counselling	515			
Testing for carrier status, per couple	1479			
Clinical diagnosis CF	9986	8000	12,000	Triangular
Lifetime costs of treatment for clinically diagnosed patient	895,291	750,000	1,200,000	Triangular
Number of sweat tests per screen positive child	1.17			
Savings in lifetime costs of treatment due to screening	0%		5%	Uniform
Number of sweat tests for diagnosis of non-CF patients per clinically diagnosed CF patient	100 without screening. With screening: 50% of no without screening	With screening: 10% of no without screening	With screening: 100% of no without screening	Triangular